Mikrotik - Part5

Consol and other

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Manual:Port

Applies to RouterOS: v5+

Summary

There are many ways how to use ports on the routers. Most obvious one is to use serial port for initial RouterOS configuration after installation(by default serial0 is used by serial-terminal).

Serial and USB ports can also be used to:

- connect 3G modems;
- connect to another device through a serial cable
- access device connected to serial cable remotely.

General

Sub-menu: `/port`

Menu lists all available serial, usb, ... ports on the router and allows to configure port parameters, like baud-rate, flow-control, etc.

Below you can see default port configuration on RB493.

```
[admin@RB493G] /port> print
Flags: I - inactive
 #    NAME                            CHANNELS USED-BY                        BAUD-RATE
 0    serial0                                1 serial-terminal                 115200
```

Note: List of the ports are maintained automatically by the RouterOS.

Properties

Property	Description
baud-rate (*integer* | *auto*; Default: **auto**)	Baud rate (speed) used by the port. If set to **auto**, then RouterOS tries to detect baud rate automatically.
data-bits (*7* | *8*; Default:)	The number of data bits in each character. • **7** - true ASCII • **8** - any data (matches the size of a byte)
dtr (*on* | *off*; Default:)	Whether to enable RS-232 DTR signal circuit used by flow control.
flow-control (*hardware* | *none* | *xon-xoff*; Default:)	method of flow control to pause and resume the transmission of data.
name (*string*; Default:)	Name of the port.
parity (*even* | *none* | *odd*; Default:)	Error detection method. If enabled, extra bit is sent to detect the communication errors. In most cases parity is set to **none** and errors are handled by the communication protocol.
rts (*on* | *off*; Default:)	Whether to enable RS-232 RTS signal circuit used by flow control.
stop-bits (*1* | *2*; Default:)	Stop bits sent after each character. Electronic devices usually uses 1 stop bit.

Read-only properties

Property	Description
channels (*integer*)	Number of channels supported by the port.
inactive (*yes* | *no*)	
line-state ()	
used-by (*string*)	Shows what is using current port. For example, by default **Serial0** is used by serial-console.

Firmware

Sub-menu: `/port firmware`

This submenu allows to specify **directory** where drivers for 3g modems can be uploaded and used.

Remote Access

Sub-menu: `/port remote-access`

If you want to access serial device that can only talk to COM ports and is located somewhere else behind router, then you can use remote-access.

As defined in RFC 2217 RouterOS can transfer data from/to a serial device over TCP connection.

Enabling remote access on RouterOS is very easy:

```
/port remote-access add port=serial0 protocol=rfc2217 tcp-port=9999
```

Note: By default serial0 is used by serial-terminal. Without releasing the port, it cannot be used by remote-access or other services

Properties

Property	Description
allowed-addresses (*IP address range*; Default: **0.0.0.0/0**)	Range of IP addresses allowed to access port remotely.
channel (*integer [0..4294967295]*; Default: **0**)	Port channel that will be used. If port has only one channel then channel number should always be **0**.
disabled (*yes* | *no*; Default: **no**)	
local-address (*IP address*; Default:)	IP address used as source address.
log-file (*string*; Default: "")	Name of the file, where communication will be logged. By default logging is disabled.
port (*string*; Default:)	Name of the port from Port list.
protocol (*raw* | *rfc2217*; Default: **rfc2217**)	RFC 2217 defines a protocol to transfer data from/to a serial device over TCP. If set to **raw**, then data is sent to serial as is.
tcp-port (*integer [1..65535]*; Default: **0**)	TCP port on which to listen for incoming connections.

Read-only properties

Property	Description
active (*yes* | *no*)	Whether remote access is active and ready to accept connection.
busy (*yes* | *no*)	Whether port is currently busy.
inactive (*yes* | *no*)	
logging-active (*yes* | *no*)	Whether logging to file is currently running
remote-address (*IP address*)	IP address of remote location that is currently connected.

See More

- Special Login
- Serial Console
- Serial Port Usage

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Manual:Console

Applies to RouterOS: 2.9, v3, v4

Overview

The console is used for accessing the MikroTik Router's configuration and management features using text terminals, either remotely using serial port, telnet, SSH or console screen within Winbox, or directly using monitor and keyboard. The console is also used for writing scripts. This manual describes the general console operation principles. Please consult the Scripting Manual on some advanced console commands and on how to write scripts.

Hierarchy

The console allows configuration of the router's settings using text commands. Since there is a lot of available commands, they are split into groups organized in a way of hierarchical menu levels. The name of a menu level reflects the configuration information accessible in the relevant section, eg. **/ip hotspot**.

Example

For example, you can issue the **/ip route print** command:

```
[admin@MikroTik] > ip route print
Flags: X - disabled, A - active, D - dynamic,
C - connect, S - static, r - rip, b - bgp, o - ospf, m - mme,
B - blackhole, U - unreachable, P - prohibit
 #      DST-ADDRESS        PREF-SRC        G GATEWAY         DIS INTE...
 0 A S  0.0.0.0/0                          r 10.0.3.1        1   bridge1
 1 ADC  1.0.1.0/24         1.0.1.1                           0   bridge1
 2 ADC  1.0.2.0/24         1.0.2.1                           0   ether3
 3 ADC  10.0.3.0/24        10.0.3.144                        0   bridge1
```

```
 4 ADC  10.10.10.0/24      10.10.10.1                      0   wlan1
[admin@MikroTik] >
```

Instead of typing **ip route** path before each command, the path can be typed only once to move into this particular branch of menu hierarchy. Thus, the example above could also be executed like this:

```
[admin@MikroTik] > ip route
[admin@MikroTik] ip route> print
Flags: X - disabled, A - active, D - dynamic,
C - connect, S - static, r - rip, b - bgp, o - ospf, m - mme,
B - blackhole, U - unreachable, P - prohibit
 #      DST-ADDRESS        PREF-SRC        G GATEWAY         DIS INTE...
 0 A S  0.0.0.0/0                          r 10.0.3.1        1   bridge1
 1 ADC  1.0.1.0/24         1.0.1.1                           0   bridge1
 2 ADC  1.0.2.0/24         1.0.2.1                           0   ether3
 3 ADC  10.0.3.0/24        10.0.3.144                        0   bridge1
 4 ADC  10.10.10.0/24      10.10.10.1                        0   wlan1
[admin@MikroTik] ip route>
```

Notice that the prompt changes in order to reflect where you are located in the menu hierarchy at the moment. To move to the top level again, type " **/** "

```
[admin@MikroTik] > ip route
[admin@MikroTik] ip route> /
[admin@MikroTik] >
```

To move up one command level, type " **..** "

```
[admin@MikroTik] ip route> ..
[admin@MikroTik] ip>
```

You can also use **/** and **..** to execute commands from other menu levels without changing the current level:

```
[admin@MikroTik] ip route> /ping 10.0.0.1
10.0.0.1 ping timeout
2 packets transmitted, 0 packets received, 100% packet loss
[admin@MikroTik] ip firewall nat> .. service-port print
Flags: X - disabled, I - invalid
 #   NAME                                                                PORTS
 0   ftp                                                                 21
 1   tftp                                                                69
 2   irc                                                                 6667
 3   h323
 4   sip
 5   pptp
[admin@MikroTik] ip firewall nat>
```

Item Names and Numbers

Many of the command levels operate with arrays of items: interfaces, routes, users etc. Such arrays are displayed in similarly looking lists. All items in the list have an item number followed by flags and parameter values.

To change properties of an item, you have to use **set** command and specify name or number of the item.

Item Names

Some lists have items with specific names assigned to each of them. Examples are **interface** or **user** levels. There you can use item names instead of item numbers.

You do not have to use the **print** command before accessing items by their names, which, as opposed to numbers, are not assigned by the console internally, but are properties of the items. Thus, they would not change on their own. However, there are all kinds of obscure situations possible when several users are changing router's configuration at the same time. Generally, item names are more "stable" than the numbers, and also more informative, so you should prefer them to numbers when writing console scripts.

Item Numbers

Item numbers are assigned by the print command and are not constant - it is possible that two successive print commands will order items differently. But the results of last print commands are memorized and, thus, once assigned, item numbers can be used even after **add**, **remove** and **move** operations (since version 3, **move** operation does not renumber items). Item numbers are assigned on a per session basis, they will remain the same until you quit the console or until the next print command is executed. Also, numbers are assigned separately for every item list, so **ip address print** will not change numbering of the interface list.

Since version 3 it is possible to use item numbers without running **print** command. Numbers will be assigned just as if the **print** command was executed.

You can specify multiple items as targets to some commands. Almost everywhere, where you can write the number of item, you can also write a list of numbers.

```
[admin@MikroTik] > interface print
Flags: X - disabled, D - dynamic, R - running
  #    NAME                TYPE             MTU
  0  R ether1               ether            1500
  1  R ether2               ether            1500
  2  R ether3               ether            1500
  3  R ether4               ether            1500
[admin@MikroTik] > interface set 0,1,2 mtu=1460
[admin@MikroTik] > interface print
Flags: X - disabled, D - dynamic, R - running
  #    NAME                TYPE             MTU
  0  R ether1               ether            1460
  1  R ether2               ether            1460
  2  R ether3               ether            1460
  3  R ether4               ether            1500
[admin@MikroTik] >
```

Quick Typing

There are two features in the console that help entering commands much quicker and easier - the [Tab] key completions, and abbreviations of command names. Completions work similarly to the bash shell in UNIX. If you press the [Tab] key after a part of a word, console tries to find the command within the current context that begins with this word. If there is only one match, it is automatically appended, followed by a space:

*/inte***[Tab]**_ becomes **/interface** _

If there is more than one match, but they all have a common beginning, which is longer than that what you have typed, then the word is completed to this common part, and no space is appended:

*/interface set e***[Tab]**_ becomes **/interface set ether**_

If you've typed just the common part, pressing the tab key once has no effect. However, pressing it for the second time shows all possible completions in compact form:

```
[admin@MikroTik] > interface set e[Tab]_
[admin@MikroTik] > interface set ether[Tab]_
[admin@MikroTik] > interface set ether[Tab]_
ether1 ether5
[admin@MikroTik] > interface set ether_
```

The **[Tab]** key can be used almost in any context where the console might have a clue about possible values - command names, argument names, arguments that have only several possible values (like names of items in some lists or name of protocol in firewall and NAT rules). You cannot complete numbers, IP addresses and similar values.

Another way to press fewer keys while typing is to abbreviate command and argument names. You can type only beginning of command name, and, if it is not ambiguous, console will accept it as a full name. So typing:

```
[admin@MikroTik] > pi 10.1 c 3 si 100
```

equals to:

```
[admin@MikroTik] > ping 10.0.0.1 count 3 size 100
```

It is possible to complete not only beginning, but also any distinctive substring of a name: if there is no exact match, console starts looking for words that have string being completed as first letters of a multiple word name, or that simply contain letters of this string in the same order. If single such word is found, it is completed at cursor position. For example:

```
[admin@MikroTik] > interface x[TAB]_
[admin@MikroTik] > interface export _

[admin@MikroTik] > interface mt[TAB]_
[admin@MikroTik] > interface monitor-traffic _
```

General Commands

There are some commands that are common to nearly all menu levels, namely: **print, set, remove, add, find, get, export, enable, disable, comment, move**. These commands have similar behavior throughout different menu levels.

- **add** - this command usually has all the same arguments as **set**, except the item number argument. It adds a new item with the values you have specified, usually at the end of the item list, in places where the order of items is relevant. There are some required properties that you have to supply, such as the interface for a new address, while other properties are set to defaults unless you explicitly specify them.

- Common Parameters
  - *copy-from* - Copies an existing item. It takes default values of new item's properties from another item. If you do not want to make exact copy, you can specify new values for some properties. When copying items that have names, you will usually have to give a new name to a copy
  - *place-before* - places a new item before an existing item with specified position. Thus, you do not need to use the move command after adding an item to the list
  - *disabled* - controls disabled/enabled state of the newly added item(-s)
  - *comment* - holds the description of a newly created item
- Return Values
  - add command returns internal number of item it has added

- **edit** - this command is associated with the **set** command. It can be used to edit values of properties that contain large amount of text, such as scripts, but it works with all editable properties. Depending on the capabilities of the terminal, either a fullscreen editor, or a single line editor is launched to edit the value of the specified property.
- **find** - The find command has the same arguments as set, plus the flag arguments like *disabled* or *active* that take values *yes* or *no* depending on the value of respective flag. To see all flags and their names, look at the top of **print** command's output. The **find** command returns internal numbers of all items that have the same values of arguments as specified.
- **move** - changes the order of items in list.
  - Parameters
    - first argument specifies the item(-s) being moved.
    - second argument specifies the item before which to place all items being moved (they are placed at the end of the list if the second argument is omitted).
- **print** - shows all information that's accessible from particular command level. Thus, **/system clock print** shows system date and time, **/ip route print** shows all routes etc. If there's a list of items in current level and they are not read-only, i.e. you can change/remove them (example of read-only item list is /system history, which shows history of executed actions), then print command also assigns numbers that are used by all commands that operate with items in this list.
  - Common Parameters
    - *from* - show only specified items, in the same order in which they are given.
    - *where* - show only items that match specified criteria. The syntax of *where* property is similar to the **find** command.
    - *brief* - forces the print command to use tabular output form
    - *detail* - forces the print command to use property=value output form
    - *count-only* - shows the number of items
    - *file* - prints the contents of the specific submenu into a file on the router.
    - *interval* - updates the output from the *print* command for every interval seconds.
    - *oid* - prints the OID value for properties that are accessible from SNMP
    - *without-paging* - prints the output without stopping after each screenful.
- **remove** - removes specified item(-s) from a list.
- **set** - allows you to change values of general parameters or item parameters. The set command has arguments with names corresponding to values you can change. Use ? or double [Tab] to see list of all arguments. If there is a list of items in this command level, then set has one action argument that accepts the number of item (or list of numbers) you wish to set up. This command does not return anything.

Modes

Console line editor works either in multiline mode or in single line mode. In multiline mode line editor displays complete input line, even if it is longer than single terminal line. It also uses full screen editor for editing large text values, such as scripts. In single line mode only one terminal line is used for line editing, and long lines are shown truncated around the cursor. Full screen editor is not used in this mode.

Choice of modes depends on detected terminal capabilities.

List of keys

Control-C
: keyboard interrupt.

Control-D
: log out (if input line is empty)

Control-K
: clear from cursor to the end of line

Control-X
: toggle safe mode

Control-V
: toggle hotlock mode mode

F6
: toggle cellar

F1 or ?
: show context sensitive help. If the previous character is \, then inserts literal ?.

Tab
: perform line completion. When pressed second time, show possible completions.

Delete
: remove character at cursor

Control-H or Backspace
: remove character before cursor and move cursor back one position.

Control-\
: split line at cursor. Insert newline at cursor position. Display second of the two resulting lines.

Control-B or Left
: move cursor backwards one character

Control-F or Right
: move cursor forward one character

Control-P or Up
: go to previous line. If this is the first line of input then recall previous input from history.

Control-N or Down
: go to next line. If this is the last line of input then recall next input from history.

Control-A or Home

move cursor to the beginning of the line. If cursor is already at the beginning of the line, then go to the beginning of the first line of current input.

Control-E or End

move cursor to the end of line. If cursor is already at the end of line, then move it to the end of the last line of current input.

Control-L or F5

reset terminal and repaint screen.

up, **down** and **split** keys leave cursor at the end of line.

Built-in Help

The console has a built-in help, which can be accessed by typing **?**. General rule is that help shows what you can type in position where the **?** was pressed (similarly to pressing **[Tab]** key twice, but in verbose form and with explanations).

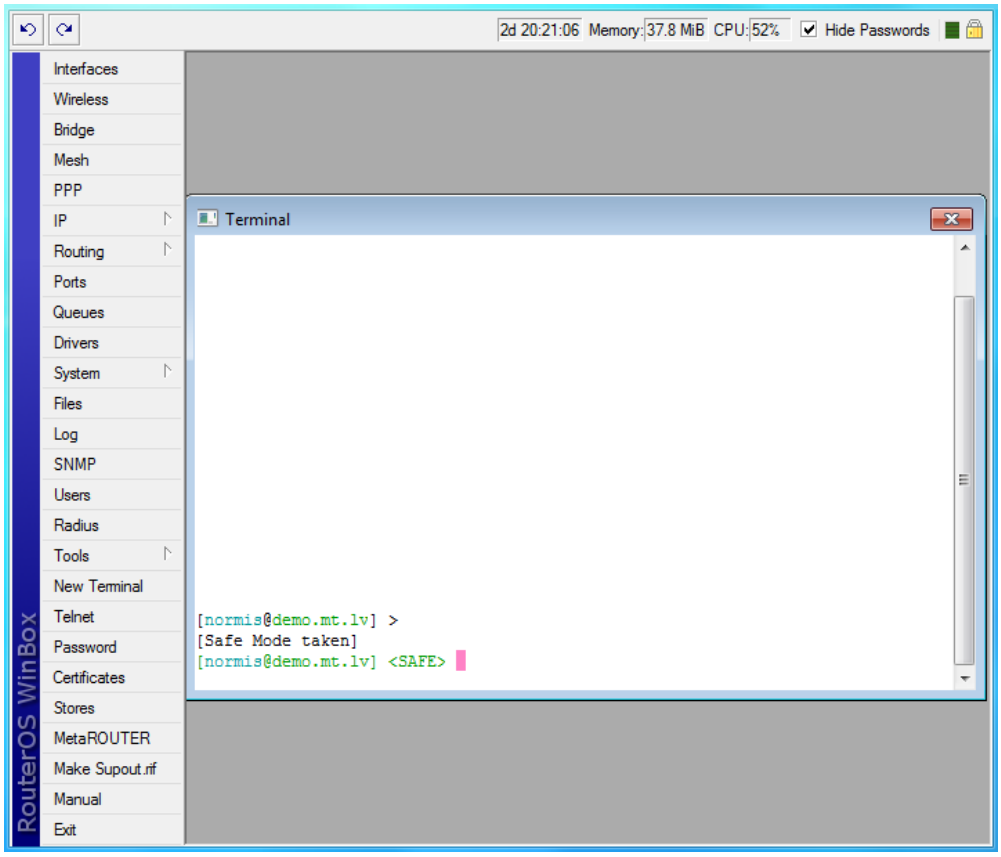
Safe Mode

It is sometimes possible to change router configuration in a way that will make the router inaccessible (except from local console). Usually this is done by accident, but there is no way to undo last change when connection to router is already cut. Safe mode can be used to minimize such risk.

Safe mode is entered by pressing **[CTRL]+[X]**. To save changes and quit safe mode, press **[CTRL]+[X]** again. To exit without saving the made changes, hit **[CTRL]+[D]**

```
[admin@MikroTik] ip route>[CTRL]+[X]
[Safe Mode taken]

[admin@MikroTik] ip route<SAFE>
```



Message **Safe Mode taken** is displayed and prompt changes to reflect that session is now in safe mode. All configuration changes that are made (also from other login sessions), while router is in safe mode, are automatically undone if safe mode session terminates abnormally. You can see all such changes that will be automatically undone tagged with an **F** flag in system history:

```
[admin@MikroTik] ip route>
[Safe Mode taken]

[admin@MikroTik] ip route<SAFE> add
[admin@MikroTik] ip route<SAFE> /system history print
Flags: U - undoable, R - redoable, F - floating-undo
  ACTION                                   BY                  POLICY
F route added                              admin               write
```

Now, if telnet connection (or winbox terminal) is cut, then after a while (TCP timeout is **9** minutes) all changes that were made while in safe mode will be undone. Exiting session by **[Ctrl]+[D]** also undoes all safe mode changes, while **/quit** does not.

If another user tries to enter safe mode, he's given following message:

```
[admin@MikroTik] >
Hijacking Safe Mode from someone - unroll/release/don't take it [u/r/d]:
```

- [u] - undoes all safe mode changes, and puts the current session in safe mode.
- [r] - keeps all current safe mode changes, and puts current session in a safe mode. Previous owner of safe mode is notified about this:

```
    [admin@MikroTik] ip firewall rule input
    [Safe mode released by another user]
```

- [d] - leaves everything as-is.

If too many changes are made while in safe mode, and there's no room in history to hold them all (currently history keeps up to 100 most recent actions), then session is automatically put out of the safe mode, no changes are automatically undone. Thus, it is best to change configuration in small steps, while in safe mode. Pressing [Ctrl]+[X] twice is an easy way to empty safe mode action list.

HotLock Mode

When HotLock mode is enabled commands will be auto completed.

To enter/exit HotLock mode press **[CTRL]+[V]**.

```
[admin@MikroTik] /ip address> [CTRL]+[V]
[admin@MikroTik] /ip address>>
```

Double `>>` is indication that HotLock mode is enabled. For example if you type `/in e`, it will be auto completed to

```
[admin@MikroTik] /ip address>> /interface ethernet
```

Quick Help menu

F6 key enables menu at the bottom of the terminal which shows common key combinations and their usage.

```
[admin@RB493G] >

tab compl ? F1 help ^V hotlk ^X safe ^C brk ^D quit
```

Manual:Console login process

Applies to RouterOS: 2.9, v3, v4

Description

There are different ways to log into console:

- serial port
- console (screen and keyboard)
- telnet
- ssh
- mac-telnet
- winbox terminal

Input and validation of user name and password is done by login process. Login process can also show different informative screens (license, demo version upgrade reminder, software key information, default configuration).

At the end of successful login sequence login process prints banner and hands over control to the console process.

Console process displays system note, last critical log entries, auto-detects terminal size and capabilities and then displays command prompt]. After that you can start writing commands.

Use up arrow to recall previous commands from command history, TAB key to automatically complete words in the command you are typing, ENTER key to execute command, and Control-C to interrupt currently running command and return to prompt.

Easiest way to log out of console is to press Control-D at the command prompt while command line is empty (You can cancel current command and get an empty line with Control-C, so Control-C followed by Control-D will log you out in most cases).

Console login options

Starting from v3.14 it is possible to specify console options during login process. These options enables or disables various console features like color, terminal detection and many other.

Additional login parameters can be appended to login name after '+' sign.

```
login_name ::= user_name [ '+' parameters ]
parameters ::= parameter [ parameters ]
parameter ::= [ number ] 'a'..'z'
number ::= '0'..'9' [ number ]
```

If parameter is not present, then default value is used. If number is not present then implicit value of parameter is used.

example: admin+c80w - will disable console colors and set terminal width to 80.

Param	Default	Implicit	Description
"w"	auto	auto	Set terminal width
"h"	auto	auto	Set terminal height
"c"	on	off	disable/enable console colors
"t"	on	off	Do auto detection of terminal capabilities
"e"	on	off	Enables "dumb" terminal mode

Different information shown by login process

Banner

Login process will display MikroTik banner after validating user name and password.

```
  MMM       MMM        KKK                          TTTTTTTTTTT      KKK
  MMMM     MMMM        KKK                          TTTTTTTTTTT      KKK
  MMM MMMM MMM  III  KKK  KKK  RRRRRR     OOOOOO      TTT     III  KKK  KKK
  MMM  MM  MMM  III  KKKKK     RRR  RRR  OOO  OOO     TTT     III  KKKKK
  MMM      MMM  III  KKK KKK   RRRRRR    OOO  OOO     TTT     III  KKK KKK
  MMM      MMM  III  KKK  KKK  RRR  RRR   OOOOOO      TTT     III  KKK  KKK

  MikroTik RouterOS 3.0rc (c) 1999-2007       http://www.mikrotik.com/
```

Actual banner can be different from the one shown here if it is replaced by distributor. See also: branding.

License

After logging in for the first time after installation you are asked to read software licenses.

```
Do you want to see the software license? [Y/n]:
```

Answer y to read licenses, n if you do not wish to read licenses (question will not be shown again). Pressing SPACE will skip this step and the same question will be asked after next login.

Demo version upgrade reminder

After logging into router that has demo key, following remonder is shown:

```
UPGRADE NOW FOR FULL SUPPORT
----------------------------
FULL SUPPORT benefits:
- receive technical support
- one year feature support
- one year online upgrades
    (avoid re-installation and re-configuring your router)
To upgrade, register your license "software ID"
 on our account server www.mikrotik.com

Current installation "software ID": ABCD-456

Please press "Enter" to continue!
```

Software key information

If router does not have software key, it is running in the time limited trial mode. After logging in following information is shown:

```
ROUTER HAS NO SOFTWARE KEY
----------------------------
You have 16h58m to configure the router to be remotely accessible,
and to enter the key by pasting it in a Telnet window or in Winbox.
See www.mikrotik.com/key for more details.

Current installation "software ID": ABCD-456
Please press "Enter" to continue!
```

After entering valid software key, following information is shown after login:

```
ROUTER HAS NEW SOFTWARE KEY
----------------------------
Your router has a valid key, but it will become active
only after reboot. Router will automatically reboot in a day.

=== Automatic configuration ===

Usually after [[netinstall|installation]] or configuration [[reset]] RouterOS will apply [[default
settings]], such as an IP address.
First login into will show summary of these settings and offer to undo them.
```

```
This is an example:
<pre>
The following default configuration has been installed on your router:
-------------------------------------------------------------------------------
IP address 192.168.88.1/24 is on ether1
ether1 is enabled


-------------------------------------------------------------------------------
You can type "v" to see the exact commands that are used to add and remove
this default configuration, or you can view them later with
'/system default-configuration print' command.
To remove this default configuration type "r" or hit any other key to continue.
If you are connected using the above IP and you remove it, you will be disconnected.
```

Applying and removing of the default configuration is done using console script (you can press 'v' to review it).

Different information shown by console process after logging in

System Note

It is possible to always display some fixed text message after logging into console.

Critical log messages

Console will display last critical error messages that this user has not seen yet. See log for more details on configuration. During console session these messages are printed on screen.

```
dec/10/2007 10:40:06 system,error,critical login failure for user root from 10.0.0.1 via telnet
dec/10/2007 10:40:07 system,error,critical login failure for user root from 10.0.0.1 via telnet
dec/10/2007 10:40:09 system,error,critical login failure for user test from 10.0.0.1 via telnet
```

Prompt

- `[admin@MikroTik] /interface>` - Default command prompt, shows user name, system identity, and current command path.
- `[admin@MikroTik] /interface<SAFE>` - Prompt indicates that console session is in Safe Mode.
- `[admin@MikroTik] >>` - Prompt indicates that HotLock is turned on.
- `{(\...` - While entering multiple line command continuation prompt shows open parentheses.
- `line 2 of 3>` - While editing multiple line command prompt shows current line number and line count.
- `address:` - Command requests additional input. Prompt shows name of requested value.

Console can show different prompts depending on enabled modes and data that is being edited. Default command prompt looks like this:

```
[admin@MikroTik] /interface>
```

Default command prompt shows name of user, '@' sign and system name in brackets, followed by space, followed by current command path (if it is not '/'), followed by '>' and space. When console is in safe mode, it shows word SAFE in the command prompt.

```
[admin@MikroTik] /interface<SAFE>
```

Hotlock mode is indicated by an additional yellow '>' character at the end of the prompt.

```
[admin@MikroTik] >>
```

It is possible to write commands that consist of multiple lines. When entered line is not a complete command and more input is expected, console shows continuation prompt that lists all open parentheses, braces, brackets and quotes, and also trailing backslash if previous line ended with backslash-whitespace.

```
[admin@MikroTik] > {
{... :put (\
{(\... 1+2)}
3
```

When you are editing such multiple line entry, prompt shows number of current line and total line count instead of usual username and system name.

```
line 2 of 3> :put (\
```

Sometimes commands ask for additional input from user. For example, command '/password' asks for old and new passwords. In such cases prompt shows name of requested value, followed by colon and space.

```
[admin@MikroTik] > /password
old password: ******
new password: **********
retype new password: **********
```

FAQ

Q: ***How do I turn off colors in console?***
A: Add '+c' after login name.

Q: ***After logging in console prints rubbish on the screen, what to do?***
Q: ***My expect script does not work with newer 3.0 releases, it receives some strange characters. What are those?***
A: These sequences are used to automatically detect terminal size and capabilities. Add '+t' after login name to turn them off.

Q: ***Thank you, now terminal width is not right. How do I set terminal width?***
A: Add '+t80w' after login name, where 80 is your terminal width.

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Manual:Special Login

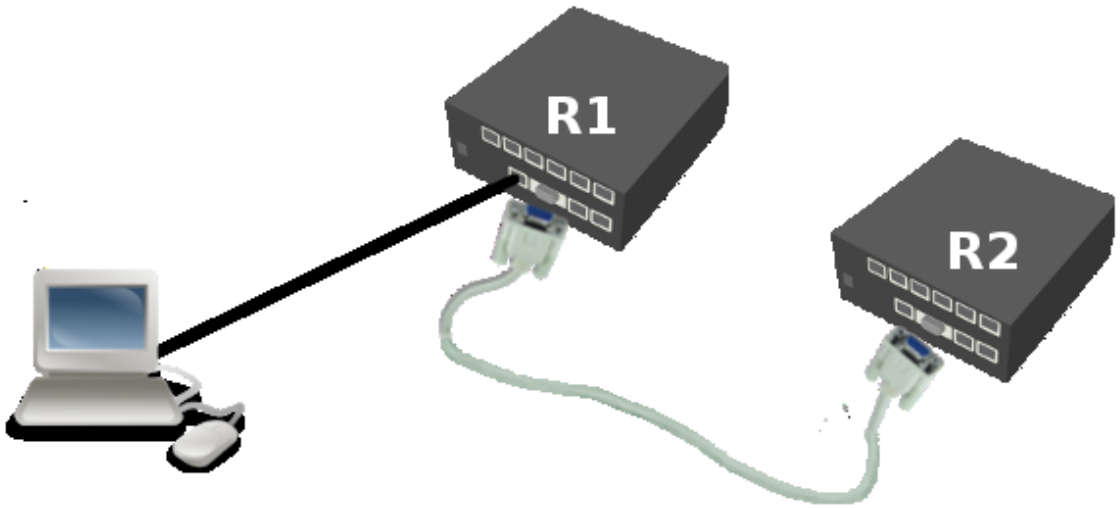
Applies to RouterOS: v3, v4, v5

Description

Special login can be used to access another device (like a switch, for example) that is connected through a serial cable by opening a telnet/ssh session that will get you directly on this device (without having to login to RouterOS first).

Setup

For demonstration we will use two RouterBoards and one PC.



Routers R1 and R2 are connected with serial cable and PC is connected to R1 via ethernet. Lets say we want to access router R2 via serial cable from our PC. To do this you have to set up serial interface proxy on R1. It can be done by feature called **special-login**.

Note: that by default console is bound to serial port.

First task is to unbind console from serial simply by disabling entry in `/system console` menu:

```
[admin@MikroTik] /system console> print
Flags: X - disabled, U - used, F - free
```

```
 #   PORT                                                                TERM
 0 X serial0                                                             vt102
```

Next step is to add new user, in this case *serial*, and bind it to the serial port

```
[admin@MikroTik] > /user add name=serial group=full
[admin@MikroTik] > /special-login add user=serial port=serial0 disabled=no
[admin@MikroTik] > /special-login print
Flags: X - disabled
 #   USER                                                                PORT
 0   serial                                                              serial0
```

Now we are ready to access R2 from our PC.

```
maris@bumba:/$ ssh serial@10.1.101.146

[Ctrl-A is the prefix key]
R2 4.0beta4
R2 Login:

[admin@R2] >
```

To exit special login mode press Ctrl+A and Q

```
[admin@MikroTik] >
[Q - quit connection]       [B - send break]
[A - send Ctrl-A prefix]    [R - autoconfigure rate]


Connection to 10.1.101.146 closed.
```

Warning: After router reboot and serial cable attached router may stuck at Bootloader main menu

To fix this problem you need to allow access bootloader main menu from <any> key to <delete>:

- enter bootloader menu
- press 'k' for boot key options
- press '2' to change key to <delete>

```
What do you want to configure?
d - boot delay
k - boot key
s - serial console
n - silent boot
o - boot device
u - cpu mode
f - cpu frequency
r - reset booter configuration
e - format nand
g - upgrade firmware
i - board info
p - boot protocol
```

```
b - booter options
t - call debug code
l - erase license
x - exit setup
your choice: k - boot key

Select key which will enter setup on boot:
 * 1 - any key
   2 - <Delete> key only

your chaoice: 2
```

See More

- Serial Console
- Sigwatch

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Manual:System/Serial Console

Applies to RouterOS: v3, v4, v5+

Overview

Sub-menu: `/system console, /system serial-terminal`
Standards: `RS-232`

The Serial Console and Terminal are tools, used to communicate with devices and other systems that are interconnected via serial port. The serial terminal may be used to monitor and configure many devices - including modems, network devices (including MikroTik routers), and any device that can be connected to a serial (asynchronous) port.

The Serial Console feature is for configuring direct-access configuration facilities (monitor/keyboard and serial port) that are mostly used for initial or recovery configuration.

If you do not plan to use a serial port for accessing another device or for data connection through a modem, you can configure it as a serial console. The first serial port is configured as a serial console, but you can choose to unconfigure it to free it for other applications. A free serial port can also be used to access other routers' (or other equipment, like switches) serial consoles from a MikroTik RouterOS router. A special null-modem cable is needed to connect two hosts (like, two PCs, or two routers; not modems). Note that a terminal emulation program (e.g., HyperTerminal on Windows or minicom on linux) is required to access the serial console from another computer.

Several customers have described situations where the Serial Terminal (managing side) feature would be useful:

- on a mountaintop, where a MikroTik wireless installation sits next to equipment (including switches and Cisco routers) that can not be managed in-band (by telnet through an IP network)
- monitoring weather-reporting equipment through a serial port
- connection to a high-speed microwave modem that needed to be monitored and managed by a serial connection

With the serial-terminal feature of the MikroTik, up to 132 (and, maybe, even more) devices can be monitored and controlled.

Serial Console Configuration

A special null-modem cable should be used for connecting to the serial console from another computer. The Serial Console cabling diagram for DB9 connectors is as follows:

Router Side (DB9f)	Signal	Direction	Side (DB9f)
1, 6	CD, DSR	IN	4
2	RxD	IN	3
3	TxD	OUT	2
4	DTR	OUT	1, 6
5	GND	-	5
7	RTS	OUT	8
8	CTS	IN	7

Note that the above diagram will not work if the software is configured to do hardware flow control, but the hardware does not support it (e.g., some RouterBOARD models have reduced seral port functionality). If this is the case, either turn off the hardware flow control or use a null-modem cable with loopback, which will simulate the other device's handshake signals with it's own. The diagram for such cable is as follows:

Router Side (DB9f)	Signal	Direction	Side (DB9f)
1, 4, 6	CD, DTR, DSR	LOOP	1, 4, 6
2	RxD	IN	3
3	TxD	OUT	2
5	GND	-	5
7, 8	RTS, CTS	LOOP	7, 8

Note that although it is recommended to have 5-wire cable for this connection, in many cases it is enough to have 3 wires (for unlooped signals only), leaving both loops to exist only inside the connectors. Other connection schemes exist as well.

Configuring Console

Sub-menu: `/system console`

Properties

Property	Description
disabled (*yes* | *no*; Default: **no**)	Whether serial console is enabled or not.
port (*string*)	Which port should the serial terminal listen to
term (*string*)	Terminal type

Read-only properties

Property	Description
free (*yes* | *no*)	Console is ready for use.
used (*yes* | *no*)	Console is in use.
vcno (*integer*)	number of virtual console - [Alt]+[F1] represents '1', [Alt]+[F2] - '2', etc..
wedged (*yes* | *no*)	Console is currently not available

Example

To disable all virtual consoles (available through the direct connection with keyboard and monitor) extept for the first one:

```
[admin@MikroTik] system console> print
Flags: X - disabled, W - wedged, U - used, F - free
 #   PORT    VCNO       TERM
 0 F serial0            MyConsole
 1 U         1          linux
 2 F         2          linux
 3 F         3          linux
 4 F         4          linux
 5 F         5          linux
 6 F         6          linux
 7 F         7          linux
 8 F         8          linux
[admin@MikroTik] system console> disable 2,3,4,5,6,7,8
[admin@MikroTik] system console> print
Flags: X - disabled, W - wedged, U - used, F - free
 #   PORT    VCNO       TERM
 0 F serial0            MyConsole
 1 U         1          linux
 2 X         2          linux
 3 X         3          linux
 4 X         4          linux
 5 X         5          linux
 6 X         6          linux
 7 X         7          linux
 8 X         8          linux
[admin@MikroTik] system console>
```

To check if the configuration of the serial port:

```
[admin@MikroTik] system serial-console> /port print detail
  0 name=serial0 used-by=Serial Console baud-rate=9600 data-bits=8 parity=none
    stop-bits=1 flow-control=none

  1 name=serial1 used-by="" baud-rate=9600 data-bits=8 parity=none stop-bits=1
    flow-control=none

[admin@MikroTik] system serial-console>
```

Using Serial Terminal

Command: `/system serial-terminal`

The command is used to communicate with devices and other systems that are connected to the router via serial port.

All keyboard input is forwarded to the serial port and all data from the port is output to the connected device. *Ctrl-A* is the prefix key, which means that you will enter a small "menu" by pressing this combination of keys. The *Ctrl-A* character will not be sent to your device! If you need to send *Ctrl-A* character to remote device, press *Ctrl-A* twice. After exiting with *Ctrl-A* and then *Q*, the control signals of the port are lowered. The speed and other parameters of serial port may be configured in the /port directory of router console. No terminal translation on printed data is performed. It is possible to get the terminal in an unusable state by outputting sequences of inappropriate control characters or random data. Do not connect to devices at an incorrect speed and avoid dumping binary data.

Property	Description
port (*string*; Default:)	Port name to use

The serial port to be used as a serial terminal needs to be free (e.g., there should not be any serial consoles, LCD or other configuration). Chack the previous chapter to see how to disable serial console on a particular port. Use /port print command to see if some other application is still using the port.

Ctrl-A have special meaning and is used to provide a possibility of exiting from nested serial-terminal sessions:

To send *Ctrl-A* to to serial port, press *Ctrl-A Ctrl-A*

Note: When rebooting a RouterBoard the bootloader (RouterBOOT) will always use the serial console (serial0 on RouterBoards) to send out some startup messages and offer access to the RouterBOOT menu. Having text coming out of the serial port to the connected device might confuse your attached device and get stuck on boot loader. To avoid this you can reconfigure RouterBOOT to enter the RouterBOOT menu only when a **DEL** character is received.

Example

To connect to a device connected to the serial1 port:

```
[admin@dzeltenais_burkaans] > /system serial-terminal serial0

[Ctrl-A is the prefix key]

[admin@R2] /ip address>
```

Console Screen

Sub-menu: `/system console screen`

This facility is created to change line number per screen if you have a monitor connected to router.

Property	Description
line count (*25|40|50*; Default: **25**)	Number of lines on monitor

This parameter is applied only to a monitor, connected to the router.

Example

To set monitor's resolution from 80x25 to 80x40:

```
[admin@MikroTik] system console screen> set line-count=40
[admin@MikroTik] system console screen> print
    line-count: 40
[admin@MikroTik] system console screen>
```

See More

- Special Login
- Sigwatch

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Manual:Scripting

Applies to RouterOS: v3, v4

Scripting language manual

This manual provides introduction to RouterOS built-in powerful scripting language.
Scripting host provides a way to automate some router maintenance tasks by means of executing user-defined scripts bounded to some event occurrence.
Scripts can be stored in Script repository or can be written directly to console. The events used to trigger script execution include, but are not limited to the System Scheduler, the Traffic Monitoring Tool, and the Netwatch Tool generated events.

Line structure

RouterOS script is divided into number of command lines. Command lines are executed one by one until the end of script or until runtime error occur.

Command line

RouterOS console uses following command syntax:
`[prefix] [path] command [uparam] [param=[value]] .. [param=[value]]`

- [prefix] - ":" or "/" character which indicates if command is ICE or path. May or may not be required.
- [path] - relative path to the desired menu level. May or may not be required.
- command - one of the commands available at the specified menu level.
- [uparam] - unnamed parameter, must be specified if command requires it.
- [params] - sequence of named parameters followed by respective values

The end of command line is represented by the token *";"* or *NEWLINE*. Sometimes *";"* or *NEWLINE* is not required to end the command line.
Single command inside `(), [] or {}` does not require any end of command character. End of command is determined by content of whole script

```
:if ( true ) do={ :put "lala" }
```

Each command line inside another command line starts and ends with square brackets "[ ]" (command concatenation).

```
:put [/ip route get [find gateway=1.1.1.1]];
```

Notice that code above contains three command lines:

- :put
- /ip route get
- find gateway=1.1.1.1

Command line can be constructed from more than one physical line by following line joining rules.

Physical Line

A physical line is a sequence of characters terminated by an end-of-line (EOL) sequence. Any of the standard platform line termination sequences can be used:

- **`unix`** – ASCII LF;
- **`windows`** – ASCII CR LF;
- **`mac`** – ASCII CR;

Standard C conventions for new line characters can be used (the \n character).

Comments

A comment starts with a hash character (#) and ends at the end of the physical line. Whitespace or any other symbols are not allowed before hash symbol. Comments are ignored by syntax. If (#) character appear inside string it is not considered a comment.

```
# this is a comment
 # bad comment
:global a; # bad comment

:global myStr "lala # this is not a comment"
```

Line joining

Two or more physical lines may be joined into logical lines using backslash character (\). A line ending in a backslash cannot carry a comment. A backslash does not continue a comment. A backslash does not continue a token except for string literals. A backslash is illegal elsewhere on a line outside a string literal.

```
:if ($a = true \
      and $b=false) do={ :put “$a $b”; }

:if ($a = true \      # bad comment
      and $b=false) do={ :put “$a $b”; }

# comment \
    continued – invalid  (syntax error)
```

Whitespace between tokens

Whitespace can be used to separate tokens. Whitespace is necessary between two tokens only if their concatenation could be interpreted as a different token. Example:

```
{
   :local a true; :local b false;
# whitespace is not required
   :put (a&&b);
# whitespace is required
   :put (a and b);
}
```

Whitespace are not allowed

- between '<parameter>='
- between 'from=' 'to=' 'step=' 'in=' 'do=' 'else='

Example:

```
#incorrect:
:for i from = 1 to = 2 do = { :put $i }
#correct syntax:
:for i from=1 to=2 do={ :put $i }
:for i from= 1 to= 2 do={ :put $i }

#incorrect
/ip route add gateway = 3.3.3.3
#correct
/ip route add gateway=3.3.3.3
```

Scopes

Variables can be used only in certain regions of the script. These regions are called scopes. Scope determines visibility of the variable. There are two types of scopes - `global` and `local`. A variable declared within a block is accessible only within that block and blocks enclosed by it, and only after the point of declaration.

Global scope

Global scope or root scope is default scope of the script. It is created automatically and can not be turned off.

Local scope

User can define its own groups to block access to certain variables, these scopes are called local scopes. Each local scope is enclosed in curly braces ("{ }").

```
{
   :local a 3;
   {
      :local b 4;
      :put ($a+$b);
   }
#line below will generate error
   :put ($a+$b);
}
```

In code above variable `b` has local scope and will not be accessible after closed curly brace.

Note: Each line written in terminal is treated as local scope

So for example, defined local variable will not be visible in next command line and will generate syntax error

```
[admin@MikroTik] > :local myVar a;
[admin@MikroTik] > :put $myVar
syntax error (line 1 column 7)
```

Warning: Do not define global variables inside local scopes.

Note that even variable can be defined as global, it will be available only from its scope unless it is not already defined.

```
{
   :local a 3;
   {
       :global b 4;
   }
   :put ($a+$b);
}
```

Code above will generate an error.

Keywords

The following words are keywords and cannot be used as variable and function names:

```
and       or        not       in
```

Delimiters

The following tokens serve as delimiters in the grammar:

```
()  []  {}  :  ;  $  /
```

Data types

RouterOS scripting language has following data types:

Type	Description
number	- 64bit signed integer, possible hexadecimal input;
boolean	- values can bee `true` or `false`;
string	- character sequence;
IP	- IP address;
internal ID	- hexadecimal value prefixed by '*' sign. Each menu item has assigned unique number - internal ID;
time	- date and time value;
array	- sequence of values organized in an array;
nil	- default variable type if no value is assigned;

Constant Escape Sequences

Following escape sequences can be used to define certain special character within string:

\"	Insert double quote
****	Insert backslash
\n	Insert newline
\r	Insert carriage return
\t	Insert horizontal tab
\$	Output $ character. Otherwise $ is used to link variable.
\?	Output ? character. Otherwise ? is used to print "help" in console.
_	- space
\a	- BEL (0x07)
\b	- backspace (0x08)
\f	- form feed (0xFF)
\v	Insert vertical tab
\xx	Print character from hex value. Hex number should use capital letters.

```
:put "\48\45\4C\4C\4F\r\nThis\r\nis\r\na\r\ntest";
```

which will show on display

```
HELLO
```

```
This
is
a
test
```

Operators

Arithmetic Operators

Usual arithmetic operators are supported in RouterOS scripting language

Opearator	Description	Example
"+"	binary addition	`:put (3+4);`
"-"	binary subtraction	`:put (1-6);`
"*"	binary multiplication	`:put (4*5);`
"/"	binary division	`:put (10 / 2); :put ((10)/2)`
"-"	unary negation	`{ :local a 1; :put (-a); }`

Note: for division to work you have to use braces or spaces around dividend so it is not mistaken as IP address

Relational Operators

Opearator	Description	Example
"<"	less	`:put (3<4);`
">"	greater	`:put (3>4);`
"="	equal	`:put (2=2);`
"<="	less or equal	
">="	greater or equal	
"!="	not equal	

Logical Operators

Opearator	Description	Example
“**!**”, “**not**”	logical NOT	`:put (!true);`
“**&&**”, “**and**”	logical AND	`:put (true&&true)`
“**||**”, “**or**”	logical OR	`:put (true||false);`
“**in**”		`:put (1.1.1.1/32 in 1.0.0.0/8);`

Bitwise Operators

Bitwise operators are working on number and ip address data types.

Opearator	Description	Example
“**~**”	bit inversion	`:put (~0.0.0.0)`
“**|**”	bitwise OR. Performs logical OR operation on each pair of corresponding bits. In each pair the result is “1” if one of bits or both bits are “1”, otherwise the result is “0”.	
“**^**”	bitwise XOR. The same as OR, but the result in each position is “1” if two bits are not equal, and “0” if bits are equal.	
“**&**”	bitwise AND. In each pair the result is “1” if first and second bit is “1”. Otherwise the result is “0”.	
“**<<**”	left shift by given amount of bits	
“**>>**”	right shift by given amount of bits	

Concatenation Operators

Opearator	Description	Example
“.”	concatenates two strings	`:put (“concatenate” . “ “ . “string”);`
“,”	concatenates two arrays or adds element to array	`:put ({1;2;3} , 5 );`

It is possible to add variable values to strings without concatenation operator:

```
:global myVar "world";

:put ("Hello " . $myVar);
# next line does the same as above
:put "Hello $myVar";
```

By using $[] and $() in string it is possible to add expressions inside strings:

```
:local a 5;
:local b 6;
:put " 5x6 = $($a * $b)";

:put " We have $[ :len [/ip route find] ] routes";
```

Other Operators

Opearator	Description	Example
"[]"	command substitution. Can contain only single command line	`:put [ :len "my test string"; ];`
"()"	sub expression or grouping operator	`:put ( "value is " . (4+5));`
"$"	substitution operator	`:global a 5; :put $a;`
"~"	binary operator that matches value against POSIX extended regular expression	Print all routes which gateway ends with 202 `/ip route print where gateway~"^[0-9 \\.]*202"`

"->"	Get an array element by key	`[admin@x86] >:global aaa {a=1;b=2}`
		`[admin@x86] > :put ($aaa->"a")`
		`1`
		`[admin@x86] > :put ($aaa->"b")`
		`2`

Variables

Scripting language has two types of variables:

- `global` - accessible from all scripts created by current user, defined by global keyword;
- `local` - accessible only within the current scope, defined by local keyword.

Note: Starting from v6.2 there can be undefined variables. When variable is undefined parser will try to look for variables set, for example, by DHCP `lease-script` or Hotspot `on-login`

Every variable, except for built in RouterOS variables, must be declared before usage by local or global keywords. Undefined variables will be marked as undefined and will result in compilation error. Example:

```
# following code will result in compilation error, because myVar is used without declaration
:set myVar "my value";
:put $myVar
```

Correct code:

```
:local myVar;
:set myVar "my value";
:put $myVar;
```

Exception is when using variables set, for example, by DHCP `lease-script`

```
/system script
add name=myLeaseScript policy=\
    ftp,reboot,read,write,policy,test,winbox,password,sniff,sensitive,api \
    source=":log info \$leaseActIP\r\
    \n:log info \$leaseActMAC\r\
    \n:log info \$leaseServerName\r\
    \n:log info \$leaseBound"

/ip dhcp-server set  myServer lease-script=myLeaseScript
```

Valid characters in variable names are letters and digits. If variable name contains any other character, then variable name should be put in double quotes. Example:

```
#valid variable name
:local myVar;
#invalid variable name
:local my-var;
#valid because double quoted
:global "my-var";
```

If variable is initially defined without value then variable data type is set to *nil*, otherwise data type is determined automatically by scripting engine. Sometimes conversion from one data type to another is required. It can be achieved using data conversion commands. Example:

```
#convert string to array
:local myStr "1,2,3,4,5";
:put [:typeof $myStr];
:local myArr [:toarray $myStr];
:put [:typeof $myArr]
```

Variable names are case sensitive.

```
:local myVar "hello"
# following line will generate error, because variable myVAr is not defined
:put $myVAr
# correct code
:put $myVar
```

Set command without value will un-define the variable (remove from environment, new in v6.2)

```
#remove variable from environment
:global myVar "myValue"
:set myVar;
```

Commands

Every global command should start with *":"* token, otherwise it will be treated as variable.

Command	Syntax	Description	Example
/		go to root menu	
..		go back by one menu level	
?		list all available menu commands and brief descriptions	
global	`:global <var> [<value>]`	define global variable	`:global myVar "something"; :put $myVar;`
local	`:local <var> [<value>]`	define local variable	`{ :local myLocalVar "I am local"; :put $myVar; }`
beep	`:beep <freq> <length>`	beep built in speaker	
delay	`:delay <time>`	do nothing for a given period of time	
put	`:put <expression>`	put supplied argument to console	
len	`:len <expression>`	return string length or array element count	`:put [:len "length=8"];`
typeof	`:typeof <var>`	return data type of variable	`:put [:typeof 4];`

pick	:pick <var> <start>[<end>]	return range of elements or substring. If end position is not specified, will return only one element from an array.	:put [:pick "abcde" 1 3]
log	:log <topic> <message>	write message to system log. Available topics are "debug, error, info and warning"	:log info "Hello from script";
time	:time <expression>	return interval of time needed to execute command	:put [:time {:for i from=1 to=10 do={ :delay 100ms }}];
set	:set <var> [<value>]	assign value to declared variable.	:global a; :set a true;
find	:find <arg> <arg> <start>	return position of substring or array element	:put [:find "abc" "a" -1];
environment	:environment print <start>	print initialized variable information	:global myVar true; :environment print;
terminal		terminal related commands	
error	:error <output>	Generate console error and stop executing the script	
parse	:parse <expression>	parse string and return parsed console commands. Can be used as function.	:global myFunc [:parse ":put hello!"]; $myFunc;
resolve	:resolve <arg>	return IP address of given DNS name	:put [:resolve "www.mikrotik.com"];
toarray	:toarray <var>	convert variable to array	
tobool	:tobool <var>	convert variable to boolean	
toid	:toid <var>	convert variable to internal ID	
toip	:toip <var>	convert variable to IP address	
toip6	:toip6 <var>	convert variable to IPv6 address	
tonum	:tonum <var>	convert variable to integer	
tostr	:tostr <var>	convert variable to string	
totime	:totime <var>	convert variable to time	

Menu specific commands

Following commands available from most sub-menus:

Command	Syntax	Description
add	add <param>=<value>..<param>=<value>	add new item
remove	remove <id>	remove selected item
enable	enable <id>	enable selected item
disable	disable <id>	disable selected item
set	set <id> <param>=<value>..<param>=<value>	change selected items parameter, more than one parameter can be specified at the time. Parameter can be unset by specifying '!' before parameter. Example: /ip firewall filter add chain=blah action=accept protocol=tcp port=123 nth=4,2 print set 0 !port chain=blah2 !nth protocol=udp

get	`get <id> <param>=<value>`	get selected items parameter value
print	`print <param><param>=[<value>]`	print menu items. Output depends on print parameters specified. Most common print parameters are described here
export	`export [file=<value>]`	export configuration from current menu and its sub-menus (if present). If file parameter is specified output will be written to file with extension '.rsc', otherwise output will be printed to console. Exported commands can be imported by import command
edit	`edit <id> <param>`	edit selected items property in built-in text editor
find	`find <expression>`	find items by given expression.

import

Import command is available from root menu and is used to import configuration from files created by export command or written manually by hand.

print parameters

Several parameters are available for print command:

Parameter	Description	Example
append		
as-value	print output as array of parameters and its values	`:put [/ip address print as-value]`
brief	print brief description	
detail	print detailed description, output is not as readable as brief output, but may be useful to view all parameters	
count-only	print only count of menu items	
file	print output to file	
follow	print all current entries and track new entries until ctrl-c is pressed, very useful when viewing log entries	`/log print follow`
follow-only	print and track only new entries until ctrl-c is pressed, very useful when viewing log entries	`/log print follow-only`
from	print parameters only from specified item	`/user print from=admin`
interval	continuously print output in selected time interval, useful to track down changes where `follow` is not acceptable	`/interface print interval=2`
terse	show details in compact and machine friendly format	
value-list	show values one per line (good for parsing purposes)	
without-paging	If output do not fit in console screen then do not stop, print all information in one piece	
where	expressions followed by where parameter can be used to filter out matched entries	`/ip route print where interface="ether1"`

More than one parameter can be specified at a time, for example, `/ip route print count-only interval=1 where interface="ether1"`

Loops and conditional statements

Command	Syntax	Description
do..while	`:do { <commands> } while=( <conditions> ); :while ( <conditions> ) do={ <commands> };`	execute commands until given condition is met.
for	`:for <var> from=<int> to=<int> step=<int> do={ <commands> }`	execute commands over a given number of iterations
foreach	`:foreach <var> in=<array> do={ <commands> };`	execute commands for each elements in list

Command	Syntax	Description
if	`:if(<condition>) do={<commands>} else={<commands>} <expression>`	If a given condition is `true` then execute commands in the `do` block, otherwise execute commands in the `else` block if specified.

Example:

```
{
   :local myBool true;
   :if ($myBool = false) do={ :put "value is false" } else={ :put "value is true" }
}
```

Functions

Scripting language does not allow to create functions directly, however you could use :parse command as a workaround.

Starting from v6.2 new syntax is added to easier define such functions and even pass parameters. It is also possible to return function value with **:return** command.

See examples below:

```
#define function and run it
:global myFunc do={:put "hello from function"}
$myFunc

output:
hello from function
```

```
#pass arguments to the function
:global myFunc do={:put "arg a=$a"; :put "arg '1'=$1"}
$myFunc a="this is arg a value"  "this is arg1 value"

output:
arg a=this is arg a value
arg '1'=this is arg1 value
```

Notice that there are two ways how to pass arguments:

- pass arg with specific name ("a" in our example)
- pass value without arg name, in such case arg "1", "2" .. "n" are used.

Return example

```
:global myFunc do={ :return ($a + $b)}
:put [$myFunc a=6 b=2]

output:
8
```

You can even clone existing script from script environment and use it as function.

```
#add script
 /system script add name=myScript source=":put \"Hello $myVar !\""
```

```
:global myFunc [:parse [/system script get myScript source]]
$myFunc myVar=world

output:
Hello world !
```

Warning: If function contains defined global variable which name matches the name of passed parameter, then globally defined variable is ignored, for compatibility with scripts written for older versions. This feature can change in future versions. **Avoid using parameters with same name as global variables.**

For example:

```
:global my2 "123"

:global myFunc do={ :global my2; :put $my2; :set my2 "lala"; :put $my2 }
$myFunc my2=1234
:put "global value $my2"
```

Output will be:

```
1234
lala
global value 123
```

Catch run-time errors

Starting from v6.2 scripting has ability to catch run-time errors.

For example, [code]:reslove[/code] command if failed will throw an error and break the script.

```
[admin@MikroTik] > { :put [:resolve www.example.com]; :put "lala";}
failure: dns name does not exist
```

Now we want to catch this error and proceed with our script:

```
:do {
      :put [:resolve www.example.com];
} on-error={ :put "resolver failed"};
:put "lala"

output:
```

```
resolver failed
lala
```

Operations with Arrays

Warning: Key name in array contains any character other than lowercase character, it should be put in quotes

For example:

```
[admin@ce0] > {:local a { "aX"=1 ; ay=2 }; :put ($a->"aX")}

2
```

Loop through keys and values

foreach command can be used to loop through keys and elements:

```
[admin@ce0] > :foreach k,v in={2; "aX"=1 ; y=2; 5} do={:put ("$k=$v")}

0=2
1=5
aX=1
y=2
```

Note: If array element has key then these elements are sorted in alphabetical order, elements without keys are moved before elements with keys and their order is not changed (see example above).

Script repository

Sub-menu level: `/system script`

Contains all user created scripts. Scripts can be executed in several different ways:

- **on event** - scripts are executed automatically on some facility events (scheduler, netwatch, VRRP)
- **by another script** - running script within script is allowed
- **manually** - from console executing run command or in winbox

Property	Description
name (*string*; Default: *"Script[num]"*)	name of the script

policy (*string*; Default:)	list of applicable policies: • **api** - api permissions • **ftp** - can log on remotely via ftp and send and retrieve files from the router • **local** - can log on locally via console • **password** - change passwords • **policy** - manage user policies, add and remove user • **read** - can retrieve the configuration • **reboot** - can reboot the router • **sensitive** - see passwords and other sensitive information • **sniff** - can run sniffer, torch etc • **ssh** - can log on remotely via secure shell • **telnet** - can log on remotely via telnet • **test** - can run ping, traceroute, bandwidth test • **web** - can log on remotely via http • **winbox** - winbox permissions • **write** - can retrieve and change the configuration Read more detailed policy descriptions here
source (*string*;)	Script source code

Read only status properties:

Property	Description
last-started (*date*)	Date and time when the script was last invoked.
owner (*string*)	User who created the script
run-count (*integer*)	Counter that counts how many times script has been executed

Menu specific commands

Command	Description
run (*run [id|name]*)	Execute specified script by ID or name

Environment

Sub-menu level:

- `/system script environment`
- `/environment`

Contains all user defined variables and their assigned values.

```
[admin@MikroTik] > :global example;
[admin@MikroTik] > :set example 123
[admin@MikroTik] > /environment print
"example"=123
```

Read only status properties:

Property	Description
name (*string*)	Variable name
user (*string*)	User who defined variable
value ()	Value assigned to variable

Job

Sub-menu level: `/system script job`

Contains list of all currently running scripts.
Read only status properties:

Property	Description
owner (*string*)	User who is running script
policy (*array*)	List of all policies applied to script
started (*date*)	Local date and time when script was started

Manual:Scripting-examples

CMD Scripting examples

This section contains some useful scripts and shows all available scripting features. Script examples used in this section were tested with the latest 3.x version.

Create a file

In v3.x it is not possible to create file directly, however there is a workaround

```
/file print file=myFile
/file set myFile.txt contents=""
```

Check if IP on interface have changed

Sometimes provider gives dynamic IP addresses. This script will compare if dynamic IP address is changed.

```
:global currentIP;

:local newIP [/ip address get [find interface="ether1"] address];

:if ($newIP != $currentIP) do={
    :put "ip address $currentIP changed to $newIP";
    :set currentIP $newIP;
}
```

Strip netmask

This script is useful if you need ip address without netmask (for example to use it in firewall), but "`/ip address get [id] address`" returns ip address and netmask.

Code:

```
:global ipaddress 10.1.101.1/24

:for i from=( [:len $ipaddress] - 1) to=0 do={
      :if ( [:pick $ipaddress $i] = "/") do={
            :put [:pick $ipaddress 0 $i]
      }
}
```

Another much more simple way:

```
:global ipaddress 10.1.101.1/24
:put [:pick $ipaddress 0 [:find $ipaddress "/"]]
```

Resolve host-name

Many users are asking feature to use dns names instead of IP address for radius servers, firewall rules, etc.

So here is an example how to resolve RADIUS server's IP.

Lets say we have radius server configured:

```
/radius
add address=3.4.5.6 comment=myRad
```

And here is a script that will resolve ip address, compare resolved ip with configured one and replace if not equal:

```
/system script add name="resolver" source= {

:local resolvedIP [:resolve "server.example.com"];
:local radiusID [/radius find comment="myRad"];
:local currentIP [/radius get $radiusID address];

:if ($resolvedIP != $currentIP) do={
   /radius set $radiusID address=$resolvedIP;
   /log info "radius ip updated";
}

}
```

Add this script to scheduler to run for example every 5 minutes

```
/system scheduler add name=resolveRadiusIP on-event="resolver" interval=5m
```

Write simple queue stats in multiple files

Lets consider queue namings are "some text.1" so we can search queues by last number right after the dot.

```
:local entriesPerFile 10;
:local currentQueue 0;
:local queuesInFile 0;
:local fileContent "";
#determine needed file count
:local numQueues [/queue simple print count-only] ;
:local fileCount ($numQueues / $entriesPerFile);
:if ( ($fileCount * $entriesPerFile) != $numQueues) do={
   :set fileCount ($fileCount + 1);
}

#remove old files
/file remove [find name~"stats"];

:put "fileCount=$fileCount";

:for i from=1 to=$fileCount do={
#create file
   /file print file="stats$i.txt";
#clear content
   /file set [find name="stats$i.txt"] contents="";

   :while ($queuesInFile < $entriesPerFile) do={
     :if ($currentQueue < $numQueues) do={
         :set currentQueue ($currentQueue +1);
         :put $currentQueue ;
         /queue simple
         :local internalID [find name~"\\.$currentQueue\$"];
         :put "internalID=$internalID";
         :set fileContent ($fileContent . [get $internalID target-address] . \
           " " . [get $internalID total-bytes] . "\r\n");
     }
     :set queuesInFile ($queuesInFile +1);

   }
   /file set "stats$i.txt" contents=$fileContent;
   :set fileContent "";
   :set queuesInFile 0;

}
```

Generate backup and send it by e-mail

This script generates backup file and sends it to specified e-mail address. Mail subject contains router's name, current date and time.

Note that smtp server must be configured before this script can be used. See `/tool e-mail` for configuration options.

Script:

```
/system backup save name=email_backup
/tool e-mail send file=email_backup.backup to="me@test.com" body="See attached file" \
   subject="$[/system identity get name] $[/system clock get time] $[/system clock get date] Backup")
```

Note: backup file contains sensitive information like passwords. So to get access to generated backup file, script or scheduler must have **'sensitive'** policy.

Use string as function

Code:

```
:global printA [:parse ":local A; :put \$A;" ];
$printA
```

Check bandwidth and add limitations

This script checks if download on interface is more than 512kbps, if true then queue is added to limit speed to 256kbps.

Code:

```
:foreach i in=[/interface find] do={
    /interface monitor-traffic $i once do={
        :if ($"received-bits-per-second" > 0 ) do={
            :local tmpIP [/ip address get [/ip address find interface=$i] address] ;
#            :log warning $tmpIP ;
            :for j from=( [:len $tmpIP] - 1) to=0 do={
                :if ( [:pick $tmpIP $j] = "/") do={
                    /queue simple add name=$i max-limit=256000/256000 dst-address=[:pick $tmpIP 0 $j] ;
                }
            }
        }
    }
}
```

Block access to specific websites

This script is useful if you want to block certain web sites but you don't want to use web proxy.

This example looks entries "rapidshare" and "youtube" in dns cache and adds IPs to address list named "restricted".

Before you begin, you must set up router to catch all dns requests:

```
/ip firewall nat
add action=redirect chain=dstnat comment=DNS dst-port=53 protocol=tcp to-ports=53
add action=redirect chain=dstnat dst-port=53 protocol=udp to-ports=53
```

and add firewall

```
/ip firewall filter
add chain=forward dst-address-list=restricted action=drop
```

Now we can write a script and schedule it to run, lets say, every 30 seconds.

Script Code:

```
:foreach i in=[/ip dns cache find] do={
    :local bNew "true";
    :local cacheName [/ip dns cache all get $i name] ;
#    :put $cacheName;

    :if (([:find $cacheName "rapidshare"] != 0) || ([:find $cacheName "youtube"] != 0)) do={

        :local tmpAddress [/ip dns cache get $i address] ;
#      :put $tmpAddress;

# if address list is empty do not check
        :if ( [/ip firewall address-list find ] = "") do={
            :log info ("added entry: $[/ip dns cache get $i name] IP $tmpAddress");
            /ip firewall address-list add address=$tmpAddress list=restricted comment=$cacheName;
        } else={
            :foreach j in=[/ip firewall address-list find ] do={
                :if ( [/ip firewall address-list get $j address] = $tmpAddress ) do={
                    :set bNew "false";
                }
            }
            :if ( $bNew = "true" ) do={
                :log info ("added entry: $[/ip dns cache get $i name] IP $tmpAddress");
                /ip firewall address-list add address=$tmpAddress list=restricted comment=$cacheName;
            }
        }
    }
}
```

Parse file to add ppp secrets

This script requires that entries inside the file is in following format:

username,password,local_address,remote_address,profile,service

For example:

```
janis,123,1.1.1.1,2.2.2.1,ppp_profile,myService
juris,456,1.1.1.1,2.2.2.2,ppp_profile,myService
aija,678,1.1.1.1,2.2.2.3,ppp_profile,myService
```

Code:

```
:global content [/file get [/file find name=test.txt] contents] ;
:global contentLen [ :len $content ] ;

:global lineEnd 0;
:global line "";
:global lastEnd 0;



:do {
       :set lineEnd [:find $content "\r\n" $lastEnd ] ;
       :set line [:pick $content $lastEnd $lineEnd] ;
       :set lastEnd ( $lineEnd + 2 ) ;

       :local tmpArray [:toarray $line] ;
      :if ( [:pick $tmpArray 0] != "" ) do={
      :put $tmpArray;
         /ppp secret add name=[:pick $tmpArray 0] password=[:pick $tmpArray 1] \
             local-address=[:pick $tmpArray 2] remote-address=[:pick $tmpArray 3] \
             profile=[:pick $tmpArray 4] service=[:pick $tmpArray 5];
}
} while ($lineEnd < $contentLen)
```

Detect new log entry

This script is checking if new log entry is added to particular buffer.

In this example we will use pppoe logs:

```
/system logging action
add name="pppoe"
/system logging
add action=pppoe topics=pppoe,info,!ppp,!debug
```

Log buffer will look similar to this one:

```
[admin@mainGW] > /log print where buffer=pppoe
13:11:08 pppoe,info PPPoE connection established from 00:0C:42:04:4C:EE
```

Now we can write a script to detect if new entry is added.

Code:

```
:global lastTime;

:global currentBuf [ :toarray [ /log find buffer=pppoe  ] ] ;
:global currentLineCount [ :len $currentBuf ] ;
:global currentTime [ :totime [/log get [ :pick $currentBuf ($currentLineCount -1) ] time   ] ];

:global message "";

:if ( $lastTime = "" ) do={
      :set lastTime $currentTime ;
      :set message [/log get [ :pick $currentBuf ($currentLineCount-1) ] message];

} else={
      :if ( $lastTime < $currentTime ) do={
            :set lastTime $currentTime ;
            :set message [/log get [ :pick $currentBuf ($currentLineCount-1) ] message];
      }
}
```

After new entry is detected, it is saved in "message" variable, which you can use later to parse log message, for example, to get pppoe clients mac address.

Allow use of ntp.org pool service for NTP

This script resolves the hostnames of two NTP servers, compares the result with the current NTP settings and changes the addresses if they're different. This script is required as RouterOS does not allow hostnames to be used in the NTP configuration. Two scripts are used. The first defines some system variables which are used in other scripts and the second does the grunt work:

```
# System configuration script - "GlobalVars"

:put "Setting system globals";

# System name
:global SYSname [/system identity get name];

# E-mail address to send notifications to
:global SYSsendemail "mail@my.address";

# E-mail address to send notifications from
:global SYSmyemail "routeros@my.address";

# Mail server to use
:global SYSemailserver "1.2.3.4";

# NTP pools to use (check www.pool.ntp.org)
:global SYSntpa "0.uk.pool.ntp.org";
:global SYSntpb "1.uk.pool.ntp.org";
```

```
# Check and set NTP servers - "setntppool"

# We need to use the following globals which must be defined here even
# though they are also defined in the script we call to set them.
:global SYSname;
:global SYSsendemail;
:global SYSmyemail;
:global SYSmyname;
:global SYSemailserver;
:global SYSntpa;
:global SYSntpb;

# Load the global variables with the system defaults
/system script run GlobalVars

# Resolve the two ntp pool hostnames
:local ntpipa [:resolve $SYSntpa];
:local ntpipb [:resolve $SYSntpb];

# Get the current settings
:local ntpcura [/system ntp client get primary-ntp];
:local ntpcurb [/system ntp client get secondary-ntp];

# Define a variable so we know if anything's changed.
:local changea 0;
:local changeb 0;

# Debug output
:put ("Old: " . $ntpcura . " New: " . $ntpipa);
:put ("Old: " . $ntpcurb . " New: " . $ntpipb);

# Change primary if required
:if ($ntpipa != $ntpcura) do={
    :put "Changing primary NTP";
    /system ntp client set primary-ntp="$ntpipa";
    :set changea 1;
    }

# Change secondary if required
:if ($ntpipb != $ntpcurb) do={
    :put "Changing secondary NTP";
    /system ntp client set secondary-ntp="$ntpipb";
    :set changeb 1;
    }

# If we've made a change, send an e-mail to say so.
:if (($changea = 1) || ($changeb = 1)) do={
```

```
    :put "Sending e-mail.";
    /tool e-mail send \
        to=$SYSsendemail \
        subject=($SYSname . " NTP change") \
        from=$SYSmyemail \
        server=$SYSemailserver \
        body=("Your NTP servers have just been changed:\n\nPrimary:\nOld: " . $ntpcura . "\nNew: " \
          . $ntpipa . "\n\nSecondary\nOld: " . $ntpcurb . "\nNew: " . $ntpipb);
    }
```

Scheduler entry:

```
/system scheduler add \
  comment="Check and set NTP servers" \
  disabled=no \
  interval=12h \
  name=CheckNTPServers \
  on-event=setntppool \
  policy=read,write,test \
  start-date=jan/01/1970 \
  start-time=16:00:00
```

Auto upgrade script

- Auto_upgrade_script_V3.x

Other scripts known to work with latest v3.x

- Dynamic_DNS_Update_Script_for_EveryDNS
- Dynamic_DNS_Update_Script_for_ChangeIP.com
- UPS Script

LUA Scripting examples

NOTE!

After RouterOS v4.0beta4, Lua support is removed until further notice

In v4.0beta3 Lua scripting language is integrated in console. This integration allows users to create their own functions and bypass several command line scripting limitations.
All examples below require at least basic knowledge of Lua scripting language. Good tutorials can be found here [1] as a starting point.

Print function

As stated in Lua documentation, 'print' command is not available in RouterOS compared to standard Lua release. This example will show you how to get back 'print' command

```
-- ----------------------------------------------------------------------
-- Print function
-- ----------------------------------------------------------------------
function print (...)
   local strPrintResult = ""
```

```
   if ... then
      local targs = {...}
      for i,v in ipairs(targs) do
        strPrintResult = strPrintResult .. tostring(v) .. "  "
      end
      strPrintResult = strPrintResult .. "\r\n"
      io.write(strPrintResult)
   end
end
```

Now you can include this custom function to other scripts and use this cool custom print function :)
You can also modify this function to write messages in RouterOS log.

Read and write large files

Many users requested ability to work with files. Now you can do it without limitations.
Create and write to file:

```
:global newContent "new file content\r\nanother line\r\n";
[/lua "local f=assert(io.open('/test.txt', 'w+')); f:write(newContent); f:close()" ];
```

Read file content to variable:

```
:global cnt ""
[/lua "local f=assert(io.open('/test.txt', 'r')); cnt=f:read('*all'); f:close()" ];
:put $cnt
```

Include custom function in another script

This example will show where to store and how to include your cool custom created functions into another scripts

- In router's file root directory create subdirectory named 'lua'
- On your PC create new file named customprint.lua and write this function in it.
- Upload newly created file in router's 'lua' directory that we made in first step
- Now you can test your custom lua function

```
[:lua "require 'customprint'\n print('hello from custom print function')"]
```

References

[1] http://lua-users.org/wiki/TutorialDirectory

Manual:Lua

Summary

- Version 4.0beta3 introduces preliminary support for Lua scripting language [1]. Integration with console is still in progress.
- RouterOS v4 RC1 removes Lua support indefinetly

Changes in console

- ':' and '/' namespaces are merged. Lookup rules have been changed so as not to affect existing scripts:
  - Without leading ':' or '/' names are looked up starting from the current path.
  - With leading ':' and '/' names are looked up starting from the root of the hierarchy.
  - With leading '/' current path of all subcommands is set to the path of command.
  - With leading ':' current path of subcommands is kept the same as the current path of command.

Example:

```
/ip address { #changes current path
    print   #/ip address print
    :queue simple print where interface=[get 0 interface]
        #this 'get' is '/ip address get', because
        #leading ':' does not change current path
        #for subcommands
}
```

- Value of type 'nothing' is gone.
- Command 'nothing' returns same value as the empty command '[]'. It is kept for compatibility with earlier versions.
- Value of type 'error' is gone, console error handling is unified with the Lua error hadling.
- 'error' command now immedeately raises an exception.
- New value type 'lua', holds arbitrary Lua values.
- New command 'lua' that returns lua function created from the given source string.
- Command can now also be a variable substitution, an expression or a command substitution. Result is evaluated. Example:

```
global a [parse "/interface print"]; $a
($a)
[parse "/interface print"]
[lua "io.write 'this works\\n'"]
```

- Global variables are shared between Lua and console scripts.
- There is no ':log' command anymore, it is replace by four commands 'log info', 'log error', 'log warning', 'log debug'. This change was necessary because of the root namespace merge. It preserves compatibility with previous scripts, but note that name of log topic cannot be a result of an expression.
- '/system script' items has new property 'language' that can be either 'cmd' or 'lua'. 'cmd' is for console scripts, 'lua' is for Lua scripts.
- New operator '%' that computes remainder.
- Logical operators now treat all values except nil and 'false' as 'true'. Note that empty string, empty array, number 0, IP address 0.0.0.0 and similar values are treated as a 'true', this is consistent with the Lua behaviour. Previously

values of non-boolean type were causing an error.

- Logical 'and' and 'or' operators ('&&' and '||') now use shortcut evaluation. If left hand value is sufficient for computing the operation, it is returned and the right hand value is not computed. Otherwise, operation returns the right hand value. Example:

```
put (9 or (1 / 0)) #prints 9, division is not computed
```

Changes in Lua compared to the standard release

- Lua base version is 5.1.4
- Number type is 64 bit signed integer. Floating point constants are not supported. Exponentiation does not work with negative exponents.
- Following patches are applied:
  - Byte swapping for loading bytecode [2].
  - Patch by Thierry Grellier that adds '&' '|' '^^' '<<' '>>' '~' bitwise operators. Integer division operator is not included. [3]
- Following libraries are included:
  - bitlib [4], adapted for 64 bit integer numbers.
  - md5 1.1.2 [5]
  - lpeg 0.9 [6]
- Following features of standard libraries are not available:
  - 'io.popen', 'io.pclose', 'io.tmpfile'.
  - 'os.execute', 'os.tmpname', 'os.getenv', 'os.setlocale', 'os.exit'.
  - 'debug' library.
  - All functions and constants from 'math', except 'math.abs', 'math.ceil', 'math.floor', 'math.max', 'math.min' and 'math.random'.
  - 'print'
- Following changes are made to standard functions:
  - 'pairs' now calls "__pairs" metamethod of it's argument, and falls back to 'rawpairs' call. Original 'pairs' is now renamed to 'rawpairs'. These changes allow simple way of implementing default iteration behaviour for objects, by providing "__pairs" metamethod.
  - math.random without arguments can return any 64 bit integer number. All bits of the result are random.
- "/LIB" is a virtual path that contains additional libraries. This path is not accessible for file operations.

References

[1] http://www.lua.org/
[2] http://lua-users.org/lists/lua-l/2006-02/msg00507.html
[3] http://lua-users.org/wiki/LuaPowerPatches
[4] http://luaforge.net/projects/bitlib
[5] http://www.keplerproject.org/md5
[6] http://www.inf.puc-rio.br/~roberto/lpeg/lpeg.html

Manual:System/SSH client

Overview

RouterOS provides SSH client that supports SSHv2 logins to SSH servers reachable from the router.

Requirements

For this command to be available router has to have *system* and *security* packages installed.

Available features

Simple log-in to remote host

It is able to connect to remote host and initiate ssh session. IP address supports both IPv4 and IPv6.

```
/system ssh 192.168.88.1
/system ssh 2001:db8:add:1337::beef
```

In this case user name provided to remote host is one that has logged into the router. If other value is required, then *user=<username>* has to be used.

```
/system ssh 192.168.88.1 user=lala
/system ssh 2001:db8:add:1337::beef user=lala
```

Log-in from certain IP address of the router

For testing or security reasons it may be required to log-in to other host using certain source address of the connection. In this case *src-address=<ip address>* argument has to be used. Note that IP address in this case supports both, IPv4 and IPv6.

```
/system ssh 192.168.88.1 src-address=192.168.89.2
/system ssh 2001:db8:add:1337::beef src-address=2001:db8:bad:1000::2
```

in this case, ssh client will try to bind to address specified and then initiate ssh connection to remote host.

Log-in using certificate

For this to work user has to set up public key on remote end where ssh will connect to. How to do that on RouterOS you can read here. On local end router, public and private keys have to be uploaded to be used in */user ssh-keys private* when adding private key and user name that will be able to use this key.

Warning: User with full rights on the router can change 'user' attribute value under */user ssh-keys privte*

Here private key is created for use for user *lala*

```
/user ssh-keys private import private-key-file=id_dsa public-key-file=id_dsa.pub user=lala
```

Executing remote commands

To execute remote command it has to be supplied at the end of log-in line

```
/system ssh 192.168.88.1 "/ip address print"
/system ssh 192.168.88.1 command="/ip address print"
/system ssh 2001:db8:add:1337::beef "/ip address print"
/system ssh 2001:db8:add:1337::beef command="/ip address print"
```

Warning: If server does not support pseudo-tty (ssh -T or ssh host command), like mikrotik ssh server, then it is not possible to send multiline commands via SSH

For example, sending command `"/ip address \n add address=1.1.1.1/24"` to Mikrotik router will fail.

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Manual:IP/SSH

Applies to RouterOS: v5

Summary

This menu controls if ssh server behaviour regarding port forward and authentication methods.

Settings

Property	Desciption
forwarding-enabled *(no|yes default:no)*	controls ssh port forwarding
always-allow-password-login *(no|yes default:no)*	controls ssh authentication methods, if set to yes, does not remove form allowed methods password_login

Example

To use this feature from Linux host using OpenSSH client this command can be used:

```
 ssh reamoteuser@remotehost -L port:remotehost:remoteport
```

where:

- remoteuser - user of router
- remotehost - router address (if host name is used in -L settings, router should be able to resolve this name)
- port - local port that your host will listen on
- remoteport - port on the router

If user requires telnet to router, but you do not want to allow it to be plain text, Following can be done:

```
ssh admin@192.168.88.1 -L 3000:192.168.88.1:23
```

now when user uses *telnet localhost 3000" it will log in the router using telnet over encrypted tcp connection.*

Note: we fully support SFTP v3 as described in draft-ietf-secsh-filexfer-02.txt [1] other versions can cause problems

References

[1] http://tools.ietf.org/wg/secsh/draft-ietf-secsh-filexfer/draft-ietf-secsh-filexfer-02.txt

Manual:System/Log

Applies to RouterOS: v3, v4 +

Summary

RouterOS is capable of logging various system events and status information. Logs can be saved in routers memory (RAM), disk, file, sent by email or even sent to remote syslog server (RFC 3164).

Log messages

Sub-menu level: `/log`

All messages stored in routers local memory can be printed from `/log` menu. Each entry contains time and date when event occurred, topics that this message belongs to and message itself.

```
[admin@ZalaisKapots] /log> print
jan/02/1970 02:00:09 system,info router rebooted
sep/15 09:54:33 system,info,account user admin logged in from 10.1.101.212 via winbox
sep/15 12:33:18 system,info item added by admin
sep/15 12:34:26 system,info mangle rule added by admin
sep/15 12:34:29 system,info mangle rule moved by admin
sep/15 12:35:34 system,info mangle rule changed by admin
sep/15 12:42:14 system,info,account user admin logged in from 10.1.101.212 via telnet
sep/15 12:42:55 system,info,account user admin logged out from 10.1.101.212 via telnet
01:01:58 firewall,info input: in:ether1 out:(none), src-mac 00:21:29:6d:82:07, proto UDP,
                          10.1.101.1:520->10.1.101.255:520, len 452
```

If logs are printed at the same date when log entry was added, then only time will be shown. In example above you can see that second message was added on sep/15 current year (year is not added) and the last message was added today so only the time is displayed.

Note: print command accepts several parameters that allows to detect new log entries, print only necessary messages and so on. For more information about parameters refer to scripting manual

For example following command will print all log messages where one of the topics is info and will detect new log entries until Ctrl+C is pressed

```
[admin@ZalaisKapots] /log > print follow where topics~".info"
12:52:24 script,info hello from script
-- Ctrl-C to quit.
```

If print is in follow mode you can hit 'space' on keyboard to insert separator:

```
[admin@ZalaisKapots] /log > print follow where topics~".info"
12:52:24 script,info hello from script

 = = =   = = =   = = =      = = =   = = =   = = =      = = =   = = =   = = =

-- Ctrl-C to quit.
```

Logging configuration

Sub-menu level: `/system logging`

Property	Description
action (*name*; Default: **memory**)	specifies one of the system default actions or user specified action listed in actions menu
prefix (*string*; Default:)	prefix added at the beginning of log messages
topics (*account, async, backup, bgp, calc, critical, ddns, debug, dhcp, e-mail, error, event, firewall, gsm, hotspot, igmp-proxy, info, ipsec, iscsi, isdn, l2tp, ldp, manager, mme, mpls, ntp, ospf, ovpn, packet, pim, ppp, pppoe, pptp, radius, radvd, raw, read, rip, route, rsvp, script, sertcp, state, store, system, telephony, tftp, timer, ups, warning, watchdog, web-proxy, wireless, write*; Default: **info**)	log all messages that falls into specified topic or list of topics. '**!**' character can be used before topic to exclude messages falling under this topic. For example, we want to log NTP debug info without too much details: `/system logging add topics=ntp,debug,!packet`

Actions

Sub-menu level: `/system logging action`

Property	Description
bsd-syslog (*yes|no*; Default:)	whether to use bsd-syslog as defined in RFC 3164
disk-file-count (*integer [1..65535]*; Default: **2**)	specifies number of files used to store log messages, applicable only if action=disk
disk-file-name (*string*; Default: **log**)	name of the file used to store log messages, applicable only if action=disk
disk-lines-per-file (*integer [1..65535]*; Default: **100**)	specifies maximum size of file in lines, applicable only if action=disk
disk-stop-on-full (*yes|no*; Default: **no**)	whether to stop to save log messages to disk after the specified disk-lines-per-file and disk-file-count number is reached, applicable only if action=disk

email-to (*string*; Default:)	email address where logs are sent, applicable only if action=email
memory-lines (*integer [1..65535]*; Default: **100**)	number of records in local memory buffer, applicable only if action=memory
memory-stop-on-full (*yes|no*; Default: **no**)	whether to stop to save log messages in local buffer after the specified memory-lines number is reached
name (*string*; Default:)	name of an action
remember (*yes|no*; Default:)	whether to keep log messages, which have not yet been displayed in console, applicable if action=echo
remote (*IP/IPv6 Address[:Port]*; Default: **0.0.0.0:514**)	remote logging server's IP/IPv6 address and UDP port, applicable if action=remote
src-address (*IP address*; Default: **0.0.0.0**)	source address used when sending packets to remote server
syslog-facility (*auth, authpriv, cron, daemon, ftp, kern, local0, local1, local2, local3, local4, local5, local6, local7, lpr, mail, news, ntp, syslog, user, uucp*; Default: **daemon**)	
syslog-severity (*alert, auto, critical, debug, emergency, error, info, notice, warning*; Default: **auto**)	Severity level indicator defined in RFC 3164: • Emergency: system is unusable • Alert: action must be taken immediately • Critical: critical conditions • Error: error conditions • Warning: warning conditions • Notice: normal but significant condition • Informational: informational messages • Debug: debug-level messages
target (*disk, echo, email, memory, remote*; Default: **memory**)	storage facility or target of log messages • disk - logs are saved to the hard drive more>> • echo - logs are displayed on the console screen • email - logs are sent by email • memory - logs are stored in local memory buffer • remote - logs are sent to remote host

Note: default actions can not be deleted or renamed.

Topics

Each log entry have topic which describes the origin of log message. There can be more than one topic assigned to log message. For example, OSPF debug logs have four different topics: route, ospf, debug and raw.

```
11:11:43 route,ospf,debug SEND: Hello Packet 10.255.255.1 -> 224.0.0.5 on lo0
11:11:43 route,ospf,debug,raw PACKET:
11:11:43 route,ospf,debug,raw     02 01 00 2C 0A FF FF 03 00 00 00 00 E7 9B 00 00
11:11:43 route,ospf,debug,raw     00 00 00 00 00 00 00 00 FF FF FF FF 00 0A 02 01
11:11:43 route,ospf,debug,raw     00 00 00 28 0A FF FF 01 00 00 00 00
```

List of Facility independent topics

Topic	Description
critical	Log entries marked as critical, these log entries are printed to console each time you log in.
debug	Debug log entries
error	Error messages
info	Informative log entry
packet	Log entry that shows contents from received/sent packet
raw	Log entry that shows raw contents of received/sent packet
warning	Warning message.

Topics used by various RouterOS facilities

Topic	Description
account	Log messages generated by accounting facility.
async	Log messages generated by asynchronous devices
backup	Log messages generated by backup creation facility.
bfd	Log messages generated by Manual:Routing/BFD protocol
bgp	Log messages generated by Manual:Routing/BGP protocol
calc	Routing calculation log messages.
ddns	Log messages generated by Manual:Tools/Dynamic DNS tool
dhcp	DHCP client, server and relay log messages
e-mail	Messages generated by Manual:Tools/email tool.
event	Log message generated at routing event. For example, new route have been installed in routing table.
firewall	Firewall log messages generated when **action=log** is set in firewall rule
gsm	Log messages generated by GSM devices
hotspot	Hotspot related log entries
igmp-proxy	IGMP Proxy related log entries
ipsec	IpSec log entries
iscsi	
isdn	
l2tp	Log entries generated by Manual:Interface/L2TP client and server
ldp	Manual:MPLS/LDP protocol related messages
manager	User manager log messages.
mme	MME routing protocol messages
mpls	MPLS messages
ntp	sNTP client generated log entries
ospf	Manual:Routing/OSPF routing protocol messages
ovpn	OpenVPN tunnel messages
pim	Multicast PIM-SM related messages
ppp	ppp facility messages
pppoe	PPPoE server/client related messages

pptp	PPTP server/client related messages
radius	Log entries generated by RADIUS Client
radvd	IPv6 radv deamon log messages.
read	SMS tool messages
rip	RIP routing protocol messages
route	Routing facility log entries
rsvp	Resource Reservation Protocol generated messages.
script	Log entries generated from scripts
sertcp	Log messages related to facility responsible for "/ports remote-access"
simulator	
state	DHCP Client and routing state messages.
store	Log entries generated by Store facility
system	Generic system messages
telephony	
tftp	TFTP server generated messages

timer	Log messages that are related to timers used in RouterOS. For example bgp keepalive logs
	`12:41:40 route,bgp,debug,timer KeepaliveTimer expired`
	`12:41:40 route,bgp,debug,timer RemoteAddress=2001:470:1f09:131::1`

ups	Messages generated by UPS monitoring tool
watchdog	Watchdog generated log entries
web-proxy	Log messages generated by web proxy
wireless	M:Interface/Wireless log entries.
write	SMS tool messages.

Logging to file

To log everything to file, add new log action:

```
/system logging action add name=file target=disk disk-file-name=log
```

and then make everything log using this new action:

```
/system logging action=file
```

You can log only errors there by issuing command:

```
/system logging topics=error action=file
```

This will log into files **log.0.txt** and **log.1.txt**.

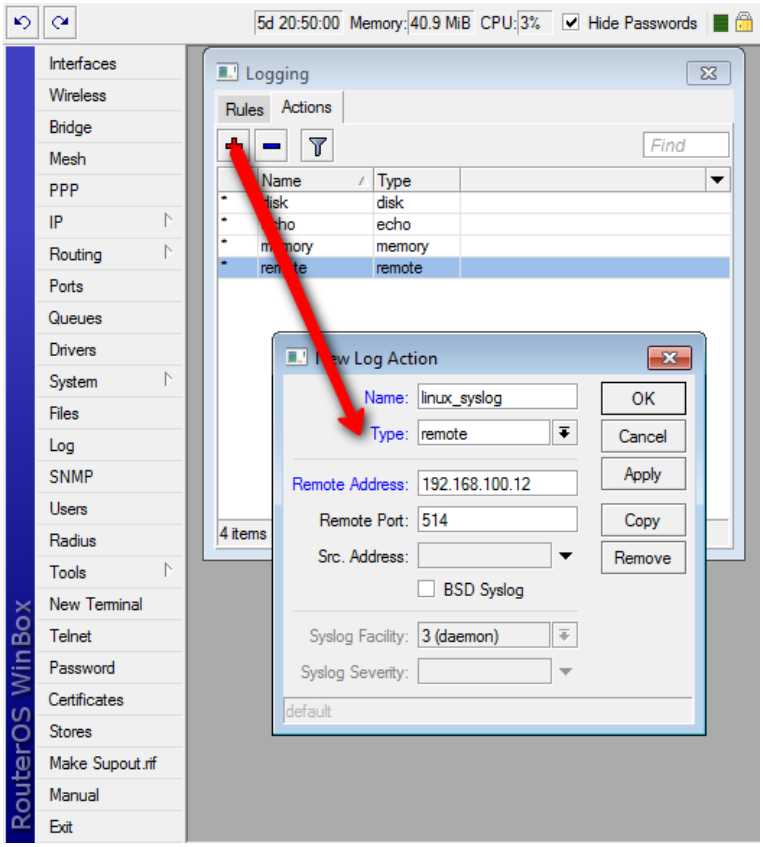
You can specify maximum size of file in lines by specifying *disk-lines-per-file*. **<file>.0.txt** is active file were new logs are going to be appended and once it size will reach maximum it will become **<file>.1.txt**, and new empty **<file>.0.txt** will be created.

You can log into USB flashes or into *MicroSD/CF* (on Routerboards) by specifying it's directory name before file name. For example, if you have accessible usb flash as **usb1** directory under */files*, you should issue following command:

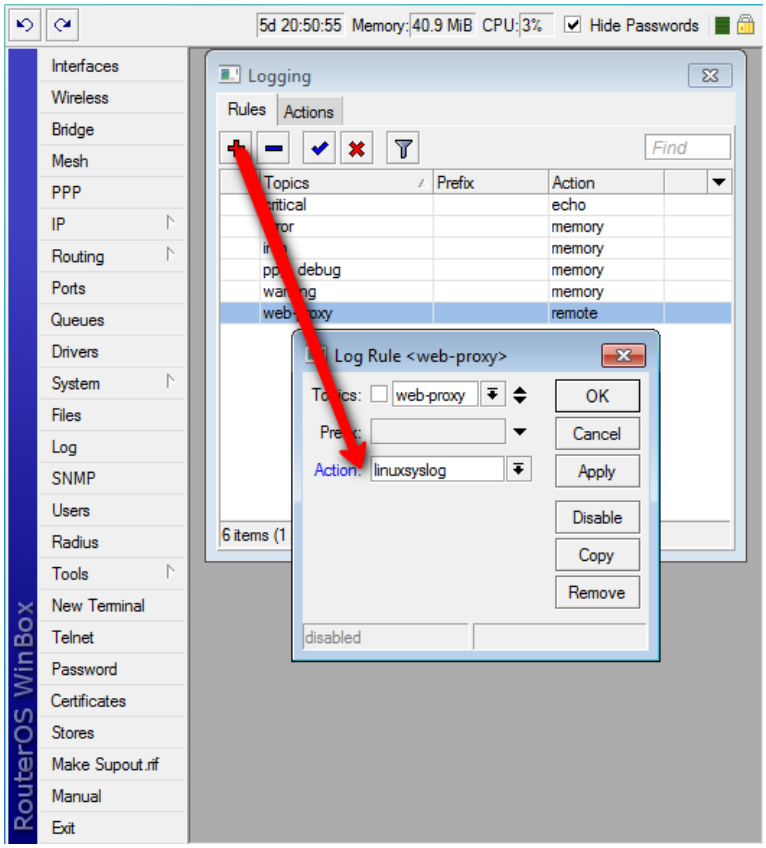
```
/system logging action add name=usb target=disk disk-file-name=usb1/log
```

Example:Webproxy logging

These two screenshots will show you how to configure the RouterOS logging facility to send Webrpoxy logs to a remote syslog server, in this example, located at 192.168.100.12. The syslog server can be any software that supports receiving syslogs, for example Kiwi syslog.



- Add a new logging action, with "remote" and the IP of the remote server. Call it whatever you like

- 

Then add a new logging rule with the topic "webproxy" and then newly created action. Note that you must have webproxy running on this router already, for this to work. To test, you can temporary change the action to "memory" and see the "log" window if the webproxy visited websites are logged. If it works, change it back to your new remote action

Note: it's a good idea to add another topic in the same rule: ***!debug****. This would be to ensure you don't get any debug stuff, only the visited sites.*

Manual:System/UPS

Applies to RouterOS: v3, v4 +

Summary

Sub-menu: `/system ups`
Standards: `APC Smart Protocol` [1]

The UPS monitor feature works with APC UPS units that support “smart” signaling over serial RS232 or USB connection. This feature enables the network administrator to monitor the UPS and set the router to ‘gracefully’ handle any power outage with no corruption or damage to the router. The basic purpose of this feature is to ensure that the router will come back online after an extended power failure. To do this, the router will monitor the UPS and set itself to hibernate mode when the utility power is down and the UPS battery is has less than 10% of its battery power left. The router will then continue to monitor the UPS (while in hibernate mode) and then restart itself after when the utility power returns. If the UPS battery is drained and the router loses all power, the router will power back to full operation when the ‘utility’ power returns.

The UPS monitor feature on the MikroTik RouterOS supports

- hibernate and safe reboot on power and battery failure
- UPS battery test and run time calibration test
- monitoring of all "smart" mode status information supported by UPS
- logging of power changes

The serial APC UPS (BackUPS Pro or SmartUPS) requires a special serial cable (unless connected with USB). If no cable came with the UPS, a cable may be ordered from APC or one can be made "in-house". Use the following diagram:

Router Side (DB9f)	Signal	Direction	UPS Side (DB9m)
2	Receive	IN	2
3	Send	OUT	1
5	Ground		4
7	CTS	IN	6

General Properties

Property	Description
alarm-setting (*delayed* | *immediate* | *low-battery* | *none*; Default: **immediate**)	UPS sound alarm setting: • `delayed` - alarm is delayed to the on-battery event • `immediate` - alarm immediately after the on-battery event • `low-battery` - alarm only when the battery is low • `none` - do not alarm
min-runtime (*time*; Default: **5m**)	Minimal run time remaining. After a 'utility' failure, the router will monitor the runtime-left value. When the value reaches the min-runtime value, the router will go to hibernate mode. • 0 - the router will go to hibernate mode when the "battery low" signal is sent indicating that the battery power is below 10%
offline-time (*time*; Default: **5m**)	How long to work on batteries. The router waits that amount of time and then goes into hibernate mode until the UPS reports that the 'utility' power is back • 0 - the router will go into hibernate mode according the min-runtime setting and 10% of battery power event. In this case, the router will wait until the UPS reports that the battery power is below 10%
port (*string*; Default:)	Communication port of the router.

Read-only properties:

Property	Description
load (*percent*)	The UPS's output load as a percentage of full rated load in Watts. The typical accuracy of this measurement is ±3% of the maximum of 105%
manufacture-date (*string*)	UPS's date of manufacture in the format "mm/dd/yy" (month, day, year).
model (*string*)	Less than 32 ASCII character string consisting of the UPS model name (the words on the front of the UPS itself)
nominal-battery-voltage (*integer*)	UPS's nominal battery voltage rating (this is not the UPS's actual battery voltage)
offline-after (*time*)	When will the router go offline
serial (*string*)	A string of at least 8 characters directly representing the UPS's serial number as set at the factory. Newer SmartUPS models have 12-character serial numbers
version (*string*)	UPS version, consists of three fields: SKU number, firmware revision, country code. The county code may be one of the following: • I - 220/230/240 Vac • D - 115/120 Vac • A - 100 Vac • M - 208 Vac • J - 200 Vac

Note: In order to enable UPS monitor, the serial port should be available.

Example

To enable the UPS monitor for port serial1:

```
[admin@MikroTik] system ups> add port=serial1 disabled=no
[admin@MikroTik] system ups> print
Flags: X - disabled, I - invalid
 0    name="ups" port=serial1 offline-time=5m min-runtime=5m
      alarm-setting=immediate model="SMART-UPS 1000" version="60.11.I"
```

```
      serial="QS0030311640" manufacture-date="07/18/00"
      nominal-battery-voltage=24V
[admin@MikroTik] system ups>
```

Runtime Calibration

Command: `/system ups rtc <id>`

The rtc command causes the UPS to start a run time calibration until less than 25% of full battery capacity is reached. This command calibrates the returned run time value.

Note: The test begins only if the battery capacity is 100%.

Monitoring

Command: `/system ups monitor <id>`

Property	Description
battery-charge ()	the UPS's remaining battery capacity as a percent of the fully charged condition
battery-voltage ()	the UPS's present battery voltage. The typical accuracy of this measurement is ±5% of the maximum value (depending on the UPS's nominal battery voltage)
frequency ()	when operating on-line, the UPS's internal operating frequency is synchronized to the line within variations within 3 Hz of the nominal 50 or 60 Hz. The typical accuracy of this measurement is ±1% of the full scale value of 63 Hz
line-voltage ()	the in-line utility power voltage
load ()	the UPS's output load as a percentage of full rated load in Watts. The typical accuracy of this measurement is ±3% of the maximum of 105%
low-battery (*yes* | *no*)	only shown when the UPS reports this status
on-battery (*yes* | *no*)	Whether UPS battery is supplying power
on-line (*yes* | *no*)	whether power is being provided by the external utility (power company)
output-voltage ()	the UPS's output voltage
overloaded-output (*yes* | *no*)	only shown when the UPS reports this status
replace-battery (*yes* | *no*)	only shown when the UPS reports this status
runtime-calibration-running (*yes* | *no*)	only shown when the UPS reports this status
runtime-left (*time*)	the UPS's estimated remaining run time in minutes. You can query the UPS when it is operating in the on-line, bypass, or on-battery modes of operation. The UPS's remaining run time reply is based on available battery capacity and output load
smart-boost-mode (*yes* | *no*)	only shown when the UPS reports this status
smart-ssdd-mode ()	only shown when the UPS reports this status
transfer-cause (*string*)	the reason for the most recent transfer to on-battery operation (only shown when the unit is on-battery)

Example

When running on utility power:

```
[admin@MikroTik] system ups> monitor 0
          on-line: yes
       on-battery: no
      RTC-running: no
     runtime-left: 20m
   battery-charge: 100%
  battery-voltage: 27V
     line-voltage: 226V
   output-voltage: 226V
             load: 45%
      temperature: 39C
        frequency: 50Hz
  replace-battery: no
      smart-boost: no
       smart-trim: no
         overload: no
      low-battery: no

[admin@MikroTik] system ups>
```

When running on battery:

```
[admin@MikroTik] system ups> monitor 0
          on-line: no
       on-battery: yes
   transfer-cause: "Line voltage notch or spike"
      RTC-running: no
     runtime-left: 19m
    offline-after: 4m46s
   battery-charge: 94%
  battery-voltage: 24V
     line-voltage: 0V
   output-voltage: 228V
             load: 42%
      temperature: 39C
        frequency: 50Hz
  replace-battery: no
      smart-boost: no
       smart-trim: no
         overload: no
      low-battery: no

      [admin@MikroTik] system ups>
```

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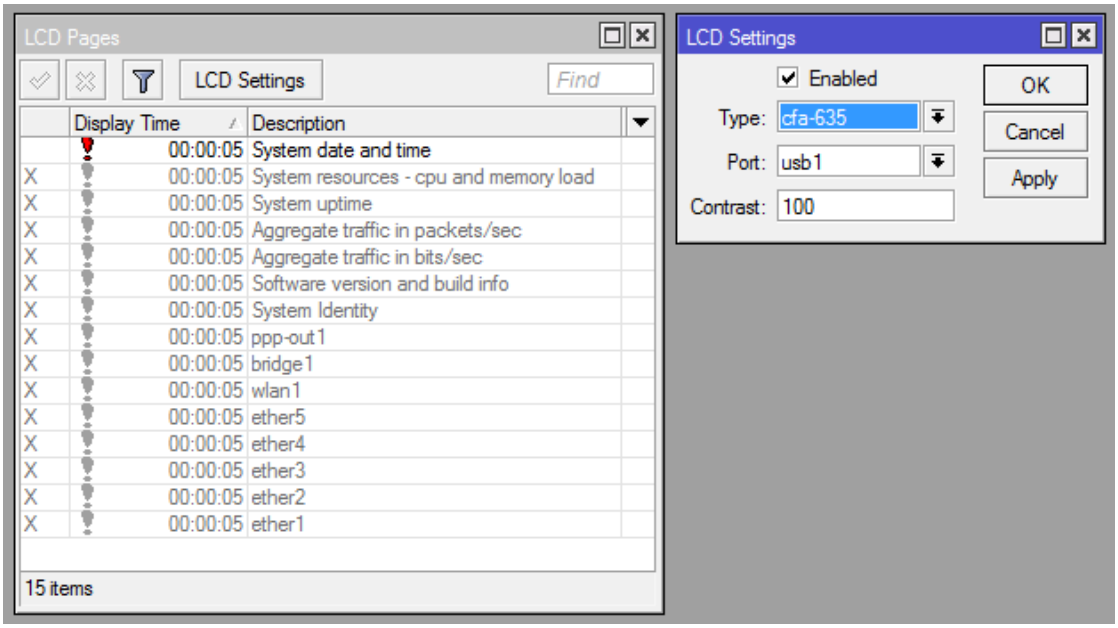
References

[1] http://www.exploits.org/nut/library/protocols/apcsmart.html

Manual:System/LCD

Applies to RouterOS: v3, v4, v5+



Summary

Sub-menu: `/system lcd`

Package: `lcd`

LCDs are used to display system information.

The MikroTik RouterOS supports the following LCD hardware.

- 16x2 characters (Baud Rate:9600)
- 16x4 characters (Baud Rate:9600)
- 20x2 characters (Baud Rate:9600)
- 20x4 characters (Baud Rate:9600)
- 24x2 characters (Baud Rate:9600)
- 24x4 characters (Baud Rate:9600)
- ax89063 (Baud Rate:9600)
- ax93304 (Baud Rate:9600)
- ax93304n (Baud Rate:9600)
- cfa-631 (Baud Rate:115200)
- cfa-633 (Baud Rate:19200)
- cfa-635 (Baud Rate:115200)
- mtb-134 (Baud Rate:2400)
- nexcom (Baud Rate:9600)
- tw-rc (Baud Rate:9600)
- vitek-vc2025-1 (Baud Rate:9600)
- vitek-vc2025-2 (Baud Rate:9600)

- Crystalfontz (http://www.crystalfontz.com) Intelligent Serial LCD Module 632 (16x2 characters) and 634 (20x4 characters)
- Powertip (http://www.powertip.com.tw) PC1602 (16x2 characters), PC1604 (16x4 characters), PC2002 (20x2 characters), PC2004 (20x4 characters), PC2402 (24x2 characters) and PC2404 (24x4 characters)
- Portwell (http://www.portwell.com.tw) EZIO-100 (16x2 characters)
- Townet (http://www.townet.it/prodotti/remote-control/tw-rc.html) TW-RC REMOTE CONTROL (16x2)
- ax93304n (serial port) new ax93304 model with smaller screen buffer (since v5.8)
- nexcom (parallel port) (since v5.8)

Properties

Property	Description
contrast (*integer [0..255]*; Default: **0**)	Contrast setting, sent to the LCD, if it contrast regulation is supported
enabled (*yes* | *no*; Default: **no**)	Turn the LCD on/off
port (*string* | *parallel*; Default: **parallel**)	Name of the port where the LCD is connected. May be either one of the serial ports, or the first parallel port
type (*16x2* | *16x4* | *20x2* | *20x4* | *24x2* | *24x4* | *ax89063* | *ax93304* | *ax93304n* | *cfa-631* | *cfa-633* | *cfa-635* | *mtb-134* | *tw-rc* | *vitek-vc2025-1* | *vitek-vc2025-2*; Default: **24x4**)	Sets the type of the LCD • **cfa-631/633/635** - Crystalfontz • **mtb-134** - Portwell EZIO-100 • **tw-rc** - TowNet TW-RC • **vitek-vc2025-1/2** - Vitek parallel port LCDs • **ax89063/ax93304/ax93304n** - Axiomtek LCDs

Example

To enable Powertip parallel port LCD:

```
[admin@MikroTik] system lcd> print
   enabled: no
      type: 24x4
      port: parallel
  contrast: 0
[admin@MikroTik] system lcd> set enabled=yes
[admin@MikroTik] system lcd> print
   enabled: yes
      type: 24x4
      port: parallel
  contrast: 0
[admin@MikroTik] system lcd>
```

To enable Crystalfontz serial LCD on serial1:

```
[admin@MikroTik] system lcd> set port=serial1
[admin@MikroTik] system lcd> print
   enabled: yes
      type: 24x4
      port: serial1
  contrast: 0
[admin@MikroTik] system lcd>
```

LCD Information Display Configuration

Sub-menu: `/system lcd page`

The submenu is used to configure LCD information display: what pages and how long they will be shown. You cannot neither add your own pages (they are created dynamically depending on the configuration) nor change pages' description.

Pages will be displayed for specified amount of time starting from the first one.

Example

To display all the pages:

```
[admin@MikroTik] system lcd page> print
Flags: X - disabled
  #   DISPLAY-TIME         DESCRIPTION
  0 X 5s               System date and time
  1 X 5s               System resources - cpu and memory load
  2 X 5s               System uptime
  3 X 5s               Aggregate traffic in packets/sec
  4 X 5s               Aggregate traffic in bits/sec
  5 X 5s               Software version and build info
  6 X 5s               ether1
  7 X 5s               prism1
[admin@MikroTik] system lcd page> enable [find]
[admin@MikroTik] system lcd page> print
Flags: X - disabled
  #   DISPLAY-TIME         DESCRIPTION
  0   5s               System date and time
  1   5s               System resources - cpu and memory load
  2   5s               System uptime
  3   5s               Aggregate traffic in packets/sec
  4   5s               Aggregate traffic in bits/sec
  5   5s               Software version and build info
  6   5s               ether1
  7   5s               prism1
[admin@MikroTik] system lcd page>
```

To set "System date and time" page to be displayed for 10 seconds:

```
[admin@MikroTik] system lcd page> set 0 display-time=10s
[admin@MikroTik] system lcd page> print
Flags: X - disabled
  #   DISPLAY-TIME         DESCRIPTION
  0   10s               System date and time
  1   5s               System resources - cpu and memory load
  2   5s               System uptime
  3   5s               Aggregate traffic in packets/sec
  4   5s               Aggregate traffic in bits/sec
  5   5s               Software version and build info
  6   5s               ether1
```

```
  7   5s                prism1
[admin@MikroTik] system lcd page>
```

Troubleshooting

LCD doesn't work, cannot be enabled by the '/system lcd set enabled=yes' command.

> Probably the selected serial port is used by PPP client or server, or by the serial console. Check the availability and use of the ports by examining the output of the /port print command. Alternatively, select another port for connecting the LCD, or free up the desired port by disabling the related resource

LCD doesn't work, does not show any information.

> Probably none of the information display items have been enabled. Use the /system lcd page set command to enable the display.

See Also

- LCD Touch Screen control

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Manual:System/GPS

Applies to RouterOS: v3, v4, v5 +

Summary

Sub-menu: `/system gps`
Standards: `GPS, NMEA 0183, Simple Text Output Protocol` [1]

Global Positioning System (GPS) is used for determining precise location of a GPS receiver.

Configuration Properties

Property	Description
channel (*integer [0..4294967295]*; Default: **0**)	Port channel used by device
enabled (*yes* | *no*; Default: **no**)	Whether GPS is enabled
port (*string*; Default:)	Name of the USB/Serial port where GPS receiver is connected
set-system-time (*yes* | *no*; Default: **no**)	Whether to set router's date and time to one received from GPS.

Monitoring Status

Command: `/system gps monitor`

This command is used for monitoring the data received from a GPS receiver

Parameters:

Property	Description
date-and-time (*date*)	Date and time received from GPS
latitude (*none* | *string*)	Latitude in DM (Degrees Minute decimal) format
longitude (*none* | *string*)	Longitude in DM (Degrees Minute decimal) format
speed (*none* | *string*)	Current moving speed of the GPS unit
bearing (*none* | *string*)	The compass direction toward which a GPS is moving
valid (*yes* | *no*)	
satellites (*integer*)	Number of satellites seen by the device.

Note: The time is not stratum 1 as RouterBOARD devices do not have PPS [2] *implemented*

Basic examples

Adjust port settings specific for your device

```
[admin@MikroTik] /port> set 0 baud-rate=4800 parity=odd
[admin@MikroTik] /port> print detail
Flags: I - inactive
 0   name="usb1" used-by="GPS" channels=1 baud-rate=4800 data-bits=8 parity=odd stop-bits=1 flow-control=none
```

Enable GPS

```
[admin@MikroTik] /system gps> set enable=yes port=usb1
[admin@MikroTik] /system gps> print
          enabled: yes
             port: usb1
          channel: 0
  set-system-time: no
```

Monitor status

```
[admin@MikroTik] /system gps> monitor
  date-and-time: sep/05/2011 07:28:54
       latitude: N 56 57' 32.568''
      longitude: E 24 9' 11.568''
       altitude: -23.600000m
          speed: 0.000000 km/h
        bearing: none
          valid: yes
     satellites: 3
```

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References

[1] http://www8.garmin.com/support/text_out.html
[2] http://en.wikipedia.org/wiki/Pulse_per_second

Manual:IP/Traffic Flow

Applies to RouterOS: 2.9, v3, v4 +

Summary

Sub-menu: `/ip traffic-flow`

MikroTik Traffic-Flow is a system that provides statistic information about packets which pass through the router. Besides network monitoring and accounting, system administrators can identify various problems that may occur in the network. With help of Traffic-Flow, it is possible to analyze and optimize the overall network performance. As Traffic-Flow is compatible with Cisco NetFlow, it can be used with various utilities which are designed for Cisco's NetFlow.

Traffic-Flow supports the following NetFlow formats:

- **version 1** - the first version of NetFlow data format, do not use it, unless you have to
- **version 5** - in addition to version 1, version 5 has possibility to inlude BGP AS and flow sequence number information. Currently RouterOS does not include BGP AS numbers.
- **version 9** - a new format which can be extended with new fields and record types thank's to its template-style design

General

Sub-menu: `/ip traffic-flow`

This section lists the configuration properties of Traffic-Flow.

Property	Description
interfaces (*string* | *all*; Default: **all**)	Names of those interfaces which will be used to gather statistics for traffic-flow. To specify more than one interface, separate them with a comma.
cache-entries (*128k* | *16k* | *1k* | *256k* | *2k* | ... ; Default: **4k**)	Number of flows which can be in router's memory simultaneously.
active-flow-timeout (*time*; Default: **30m**)	Maximum life-time of a flow.
inactive-flow-timeout (*time*; Default: **15s**)	How long to keep the flow active, if it is idle. If connection does not see any packet within this timeout, then traffic-flow will send packet out as new flow. If this timeout is too small it can create significant amount of flows and overflow the buffer.

Note: Starting 6.0rc14 release setting interface will show RX and TX for the interface. Previously traffic-flow reported only RX fraffic for the interface and to see bidirecional data it was required to set up more interfaces.

Targets

Sub-menu: `/ip traffic-flow target`

With Traffic-Flow targets we specify those hosts which will gather the Traffic-Flow information from router.

Property	Description
address (*IP:port*; Default:)	IP address and port (UDP) of the host which receives Traffic-Flow statistic packets from the router.
v9-template-refresh (*integer*; Default: **20**)	Number of packets after which the template is sent to the receiving host (only for NetFlow version 9)
v9-template-timeout (*time*; Default:)	After how long to send the template, if it has not been sent.
version (*1* | *5* | *9*; Default:)	Which version format of NetFlow to use

Notes

By looking at packet flow diagram you can see that traffic flow is at the end of input, forward and output chain stack. It means that traffic flow will count only traffic that reaches one of those chains.

For example, you set up mirror port on switch, connect mirror port to router and set traffic flow to count mirrored packets. Unfortunately such setup will not work, because mirrored packets are dropped before they reach input chain.

Other interfaces will appear in report if traffic is passing thorugh them and monitored interface.

Examples

This example shows how to configure Traffic-Flow on a router

Enable Traffic-Flow on the router:

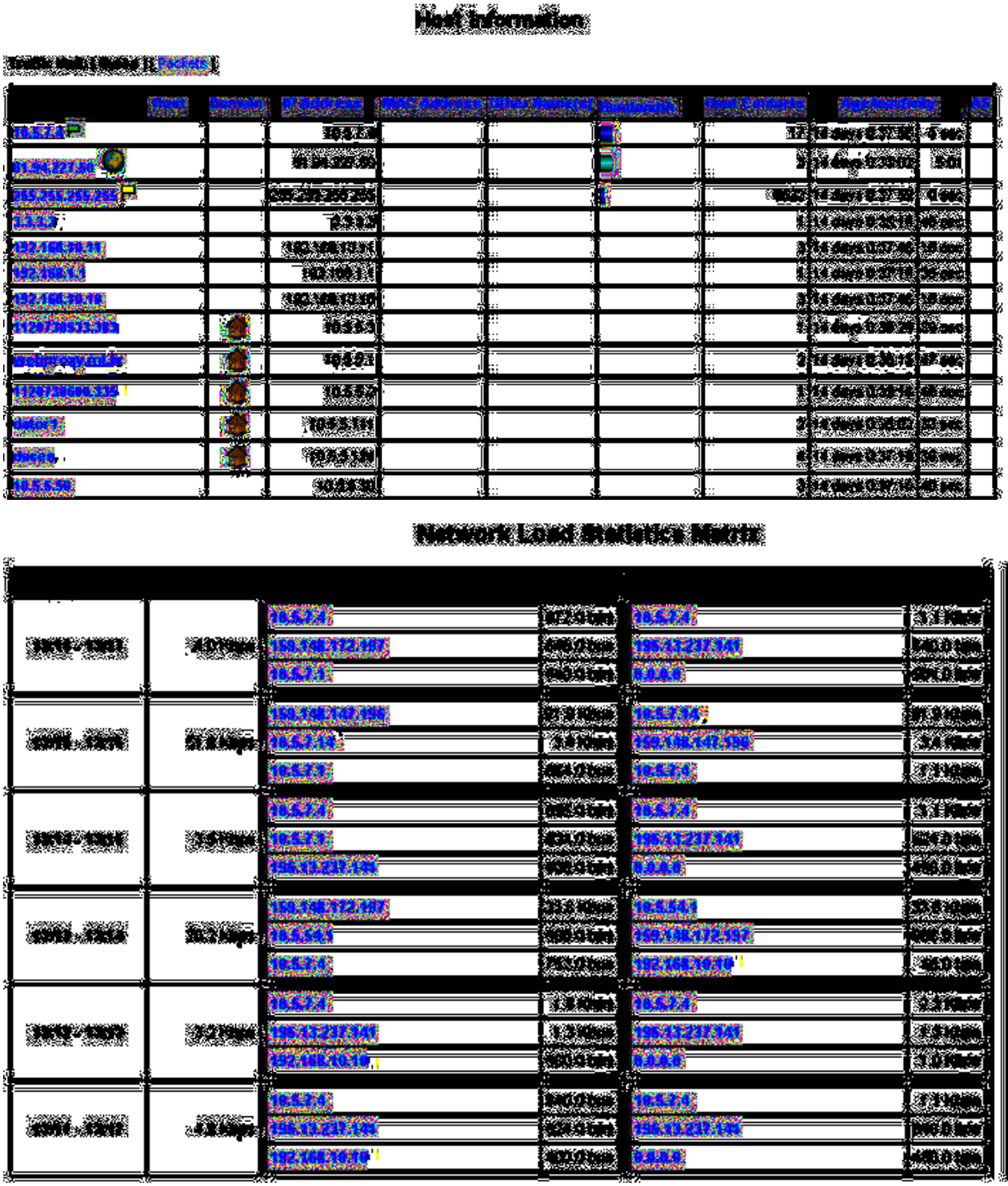
```
[admin@MikroTik] ip traffic-flow> set enabled=yes
[admin@MikroTik] ip traffic-flow> print
                 enabled: yes
              interfaces: all
           cache-entries: 1k
     active-flow-timeout: 30m
   inactive-flow-timeout: 15s
[admin@MikroTik] ip traffic-flow>
```

Specify IP address and port of the host, which will receive Traffic-Flow packets:

```
[admin@MikroTik] ip traffic-flow target> add address=192.168.0.2:2055 \
\... version=9
[admin@MikroTik] ip traffic-flow target> print
Flags: X - disabled
 #   ADDRESS               VERSION
 0   192.168.0.2:2055      9
[admin@MikroTik] ip traffic-flow target>
```

Now the router starts to send packets with Traffic-Flow information.

Some screenshots from NTop program [1], which has gathered Traffic-Flow information from our router and displays it in nice graphs and statistics. For example, where what kind of traffic has flown:



See more

- NetFlow Fundamentals [2]

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References

[1] http://www.ntop.org/download.html
[2] http://etutorials.org/Networking/network+management/Part+II+Implementations+on+the+Cisco+Devices/Chapter+7.+NetFlow/Fundamentals+of+NetFlow/

Manual:SNMP

Applies to RouterOS: v5

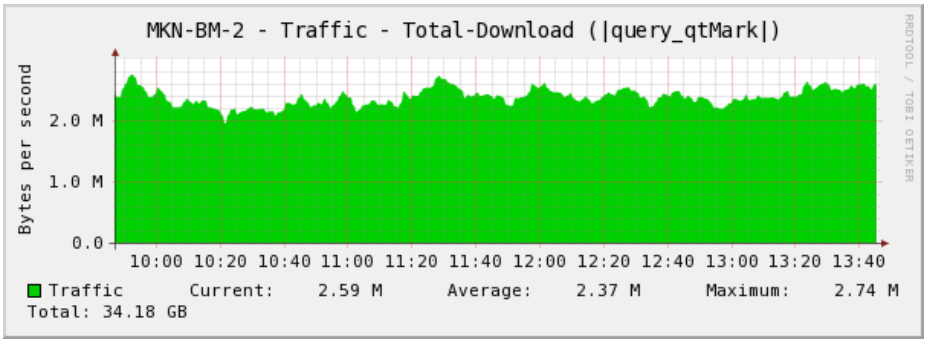
Overview

Standards: RFC 1157 RFC 3414 RFC 3416

Package: system

Simple Network Management Protocol (SNMP) is an Internet-standard protocol for managing devices on IP networks. SNMP can be used to graph various data with tools such as CACTI, MRTG or The Dude [1]

SNMP write support is only available for some OIDs. For supported OIDs SNMP v1, v2 or v3 write is supported


MKN-BM-2 - Traffic - Total-Download (|query_qtMark|)
Bytes per second
2.0 M
1.0 M
0.0
10:00 10:20 10:40 11:00 11:20 11:40 12:00 12:20 12:40 13:00 13:20 13:40
Traffic Current: 2.59 M Average: 2.37 M Maximum: 2.74 M
Total: 34.18 GB
RRDTOOL / TOBI OETIKER

Quick Configuration

To enable SNMP in RouterOS:

```
[admin@MikroTik] /snmp> print
       enabled: no
       contact:
       location:
       engine-id:
       trap-community: (unknown)
       trap-version: 1
[admin@MikroTik] /snmp>  set enabled yes
```

You can also specify administrative contact information in the above settings. All SNMP data will be available to communities configured in *community* menu.

General Properties

Sub-menu: `/snmp`

This sub menu allows to enable SNMP and to configure general settings.

Property	Description
contact (*string*; Default: "")	Contact information
enabled (*yes* | *no*; Default: **no**)	Used to disable/enable SNMP service
engine-id (*string*; Default: "")	for SNMP v3, used as part of identifier. You can configure suffix part of engine id using this argument. If SNMP client is not capable to detect set engine-id value then this prefix hex have to be used 0x80003a8c04
location (*string*; Default: "")	Location information
trap-community (*string*; Default: **public**)	Which communities configured in *community* menu to use when sending out the trap.
trap-generators (*interfaces* | *start-trap*; Default:)	What action will generate traps: • interfaces - interface changes; • start-trap - snmp server starting on the router
trap-interfaces (*string* | *all*; Default:)	List of interfaces that traps are going to be sent out.
trap-target (*list of IP/IPv6*; Default: **0.0.0.0**)	IP (IPv4 or IPv6) addresses of SNMP data collectors that have to receive the trap
trap-version (*1|2|3*; Default: **1**)	Version of SNMP protocol to use for trap

Note: engine-id field holds the suffix value of engine-id, usually SNMP clients should be able to detect the value, as SNMP values, as read from the router. However there is a possibility that this is not the case. In which case, the engine-ID value has to be set according to this rule: <engine-id prefix> + <hex-dump suffix>, so as an example, if you have set 1234 as suffix value you have to provide 80003a8c04 + 31323334, combined hex (the result) is 80003a8c0431323334

Community

Sub-menu: `/snmp community`

This sub-menu allows to set up access rights for the SNMP data.

There is little security in v1 and v2c, just Clear text community string („username“) and ability for Limiting access by IP adress.

Since SNMP v3, better options have been introduced - Authorisation (User + Pass) with MD5/SHA1, Encryption with DES.

```
[admin@MikroTik] /snmp community> print value-list
                     name: public
                  address: 0.0.0.0/0
                 security: none
              read-access: yes
             write-access: no
  authentication-protocol: MD5
```

```
    encryption-protocol: DES
authentication-password: *****
    encryption-password: *****
```

Warning: Default settings only have one community named *public* without any additional security settings. These settings should be considered insecure and should be adjusted according required security profile.

Properties

Property	Description
address (*IP/IPv6 address*; Default: **0.0.0.0/0**)	Addresses from which connections to SNMP server is allowed
authentication-password (*string*; Default: "")	Password used to authenticate connection to the server (SNMPv3)
authentication-protocol (*MD5* | *SHA1*; Default: **MD5**)	Protocol used for authentication (SNMPv3)
encryption-password (*string*; Default: "")	password used for encryption (SNMPv3)
encryption-protocol (*DES*; Default: **DES**)	encryption protocol to be used to encrypt the communication (SNMPv3)
name (*string*; Default:)	
read-access (*yes* | *no*; Default: **yes**)	Whether read access is enabled for this community
security (*authorized* | *none* | *private*; Default: **none**)	
write-access (*yes* | *no*; Default: **no**)	Whether write access is enabled for this community. Read more >>

Management information base (MIB)

The Management Information Base (MIB) is the database of information maintained by the agent that the manager can query. You can download the latest MikroTik RouterOS MIB [2] file.

MIBs used in RouterOS v5.x:

- MIKROTIK-MIB
- MIB-2
- HOST-RESOURCES-MIB
- IF-MIB
- IP-MIB
- IP-FORWARD-MIB
- IPV6-MIB
- BRIDGE-MIB
- DHCP-SERVER-MIB
- CISCO-AAA-SESSION-MIB
- ENTITY-MIB
- UPS-MIB
- SQUID-MIB

Object identifiers (OID)

Each OID identifies a variable that can be read via SNMP. Although the MIB file contains all the needed OID values, you can also print individual OID information in the console with the **print oid** command at any menu level:

```
[admin@MikroTik] /interface> print oid

Flags: D - dynamic, X - disabled, R - running, S - slave
 0  R  name=.1.3.6.1.2.1.2.2.1.2.1 mtu=.1.3.6.1.2.1.2.2.1.4.1
       mac-address=.1.3.6.1.2.1.2.2.1.6.1 admin-status=.1.3.6.1.2.1.2.2.1.7.1
       oper-status=.1.3.6.1.2.1.2.2.1.8.1 bytes-in=.1.3.6.1.2.1.2.2.1.10.1
       packets-in=.1.3.6.1.2.1.2.2.1.11.1 discards-in=.1.3.6.1.2.1.2.2.1.13.1
       errors-in=.1.3.6.1.2.1.2.2.1.14.1 bytes-out=.1.3.6.1.2.1.2.2.1.16.1
       packets-out=.1.3.6.1.2.1.2.2.1.17.1 discards-out=.1.3.6.1.2.1.2.2.1.19.1
       errors-out=.1.3.6.1.2.1.2.2.1.20.1
```

Traps

SNMP traps enable router to notify data collector of interface changes and SNMP service status changes by sending traps. It is possible to send out traps with security features to support SNMPv1 (no security). SNMPv2 and variants and SNMPv3 with encryption and authorization.

For SNMPv2 and v3 you have to set up appropriately configured community as a *trap-community* to enable required features (password or encryption/authorization)

SNMP write

Since RouterOS v3, SNMP write is supported for some functions. SNMP write allows to change router configuration with SNMP requests. Consider to secure access to router or to router's SNMP, when SNMP and write-access are enabled.

To change settings by SNMP requests, use the command below to allow SNMP write for the selected community, Write-access option for SNMP is available from v3.14,

```
/snmp community set <number> write-access=yes
```

System Identity

It's possible to change router system identity by SNMP set command,

```
snmpset -c public -v 1 192.168.0.0 1.3.6.1.2.1.1.5.0  s New_Identity
```

- *snmpset* - SNMP application used for SNMP SET requests to set information on a network entity;
- *public* - router's community name;
- *192.168.0.0* - IP address of the router;
- *1.3.6.1.2.1.1.5.0* - SNMP value for router's identity;

SNMPset command above is equal to the RouterOS command,

```
/system identity set identity=New_Identity
```

Reboot

It's possible to reboot the router with SNMP set commamd, you need to set value for reboot SNMP settings, which is not equal to 0,

```
snmpset -c public -v 1 192.168.0.0 1.3.6.1.4.1.14988.1.1.7.1.0 s 1
```

- **1.3.6.1.4.1.14988.1.1.7.1.0**, SNMP value for the router reboot;
- **s 1**, snmpset command to set value, value should not be equal to 0;

Reboot snmpset command is equal to the RouterOS command,

```
/system reboot
```

Run Script

SNMP write allows to run scripts on the router from **system script** menu, when you need to set value for SNMP setting of the script,

```
snmpset -c public -v 1 192.168.0.0 1.3.6.1.4.1.14988.1.1.8.1.1.3.X s 1
```

- **X**, script number, numeration starts from 1;
- **s 1**, snmpset command to set value, value should not be equal to 0;

The same command on RouterOS,

```
/system script> print
Flags: I - invalid
 0   name="kaka" owner="admin" policy=ftp,reboot,read,write,policy,
test,winbox,password,sniff last-started=jan/01/1970
01:31:57 run-count=23 source=:beep

/system script run 0
```

See Also

- SNMP MRTG

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References

[1] http://www.mikrotik.com/thedude.php
[2] http://mikrotik.com/download/Mikrotik.mib

Manual:Tools/Graphing

Applies to RouterOS: v3, v4, v5 +

Summary

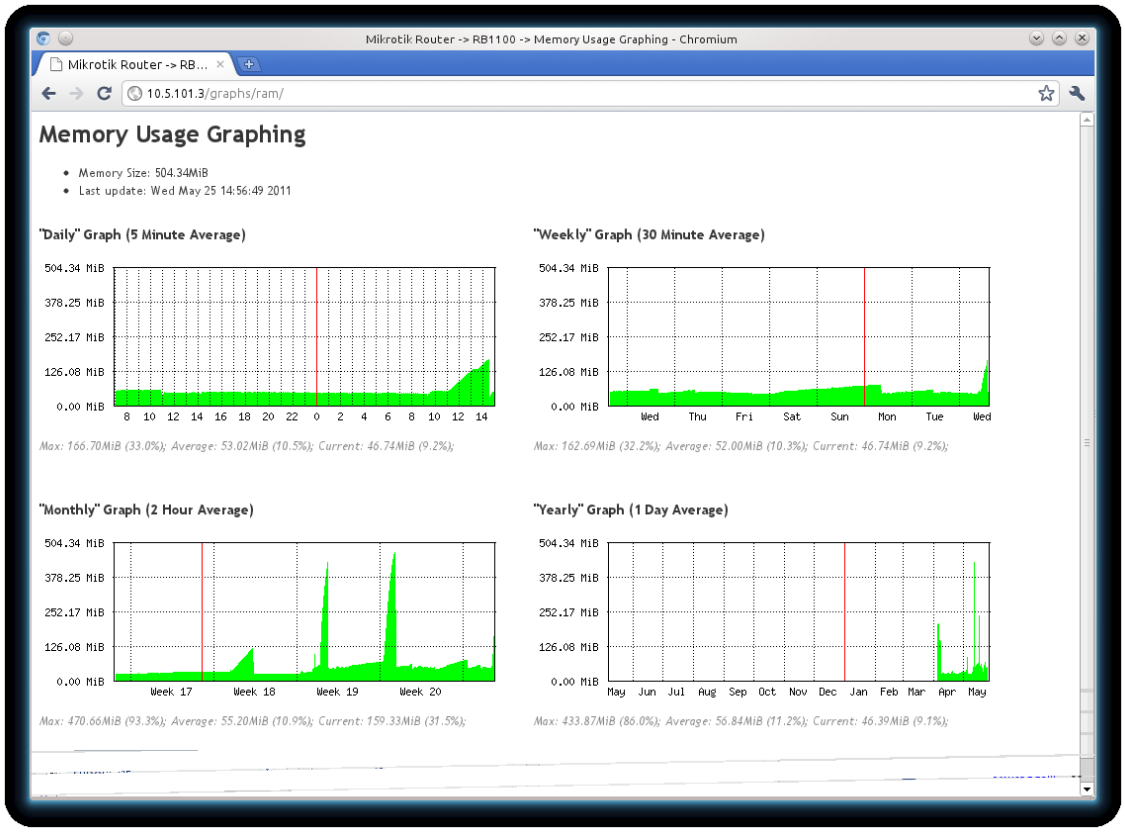
Graphing is a tool to monitor various RouterOS parameters over time and put collected data in nice graphs.

The Graphing tool can display graphics for:

- Routerboard health (voltage and temperature)
- Resource usage (CPU, Memory and Disk usage)
- Traffic which is passed through interfaces
- Traffic which is passed through simple queues

Graphing consists of two parts - first part collects information and other part displays data in a Web page. To access the graphics, type **http://[Router_IP_address]/graphs/** and choose a graphic to display in your Web browser.

Example of memory graphs:


Mikrotik Router -> RB1100 -> Memory Usage Graphing - Chromium
Mikrotik Router -> RB...
10.5.101.3/graphs/ram/
Memory Usage Graphing
Memory Size: 504.34MiB
Last update: Wed May 25 14:56:49 2011
"Daily" Graph (5 Minute Average)
"Weekly" Graph (30 Minute Average)
"Monthly" Graph (2 Hour Average)
"Yearly" Graph (1 Day Average)
504.34 MiB
378.25 MiB
252.17 MiB
126.08 MiB
0.00 MiB
Wed Thu Fri Sat Sun Mon Tue Wed
Week 17 Week 18 Week 19 Week 20
May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May

General

Sub-menu `/tool graphing`

Common graphing configuration can be set in this submenu.

Properties

Property	Description
store-every (*24hours* | *5min* | *hour*; Default: **5min**)	How often to write collected data to system drive.
page-refresh (*integer* | *never*; Default: **300**)	How often graph page is refreshed

Interface graphing

Sub-menu `/tool graphing interface`

Sub-menu allows to configure on which interfaces graphing will collect bandwidth usage data.

Properties

Property	Description
allow-address (*IP/IPv6 prefix*; Default: **0.0.0.0/0**)	IP address range from which is allowed to access graphing information
comment (*string*; Default:)	Description of current entry
disabled (*yes* | *no*; Default: **no**)	Defines whether item is used
interface (*all* | *interface name*; Default: **all**)	Defines which interface will be monitored. **all** means that all interfaces on router will be monitored.
store-on-disk (*yes* | *no*; Default: **yes**)	Defines whether to store collected information on system drive.

Queue graphing

Sub-menu `/tool graphing queue`

Sub-menu allows to configure about which simple queues graphing will collect bandwidth usage data.

Properties

Property	Description
allow-address (*IP/IPv6 prefix*; Default: **0.0.0.0/0**)	IP address range from which is allowed to access graphing information
allow-target (*yes* | *no*; Default: **yes**)	Whether to allow access to graphs from queue's target-address
comment (*string*; Default:)	Description of current entry
disabled (*yes* | *no*; Default: **no**)	Defines whether item is used
simple-queue (*all* | *queue name*; Default: **all**)	Defines which queues will be monitored. **all** means that all queues on router will be monitored.
store-on-disk (*yes* | *no*; Default: **yes**)	Defines whether to store collected information on system drive.

Note: If simple queue has target-address set to 0.0.0.0/0 everyone will be able to access queue graphs even if allow address is set to specific address. This happens because by default queue graphs are accessible also from target address.

Resource graphing

Sub-menu `/tool graphing resource`

Sub-menu allows to enable graphing of system resources. Graphing collects data of:

- CPU usage
- Memory usage
- Disk usage

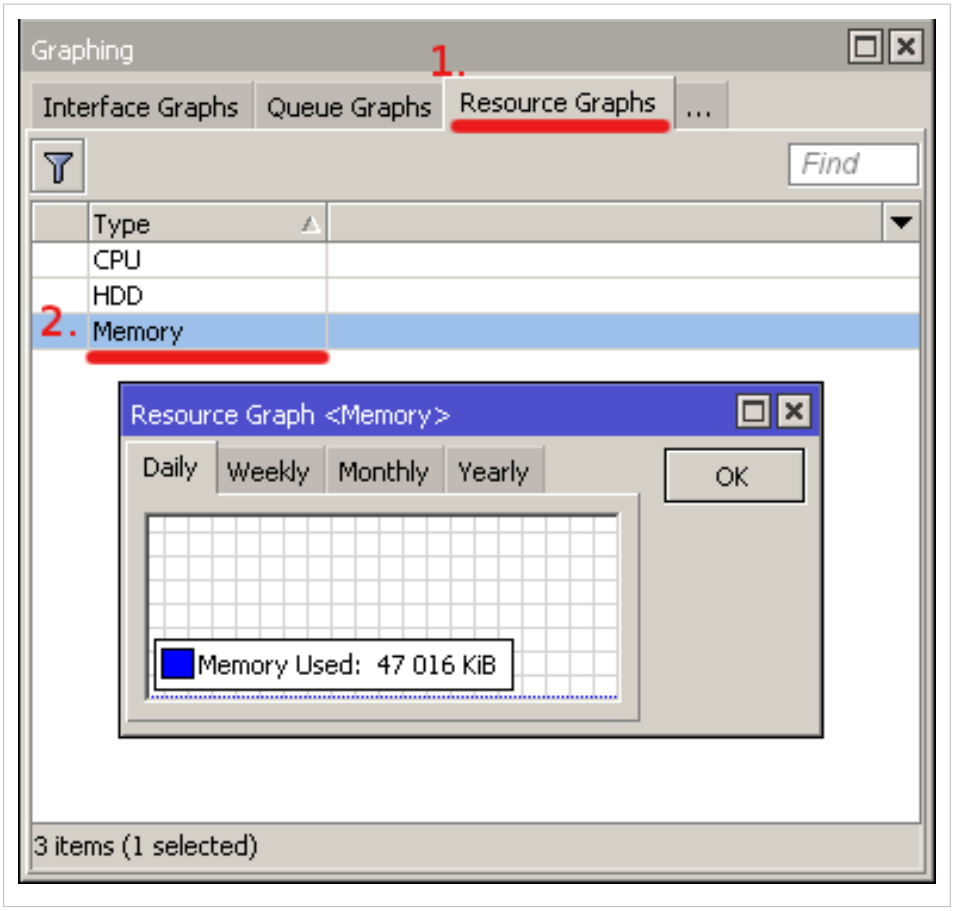
Properties

Property	Description
allow-address (*IP/IPv6 prefix*; Default: **0.0.0.0/0**)	IP address range from which is allowed to access graphing information
comment (*string*; Default:)	Description of current entry
disabled (*yes* | *no*; Default: **no**)	Defines whether item is used
store-on-disk (*yes* | *no*; Default: **yes**)	Defines whether to store collected information on system drive.

Graphing graphics in WinBox

Winbox allows to view the same collected information as in web page. Open **Tools->Graphing** window. Double click on entry of which you want to see graphs.

Image below shows winbox graphs of memory usage:



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Manual:Tools/Profiler

Applies to RouterOS: v5beta7 +

Summary

Command: `/tool profile`
Standards:

Profiler tool shows CPU usage for each process running in RouterOS. It helps to identify which process is using most of the CPU resources.

```
[admin@dzeltenais_burkaans] > /tool profile
NAME              USAGE
sstp              9%
ppp               0.5%
ethernet          0%
queue-mgmt        0%
console           0.5%
dns               0%
winbox            0%
logging           0%
management        1.5%
ospf              0%
idle              87.5%
profiling         0.5%
queuing           0%
routing           0%
bridging          0%
unclassified      0.5%
```

CPU usage on multi-core systems

On multi-core systems tool allows to specify per core CPU usage. For example, to view CPU usage on second core use following command:

```
[admin@x86-test] > /tool profile cpu=2
NAME              CPU         USAGE
ethernet          1           0%
kvm               1           2.5%
management        1           0.5%
idle              1           96.5%
profiling         1           0%
unclassified      1           0.5%
```

`"cpu"` parameter allows to specify integer number which represents a core or two of predefined values **all** and **total**

- total - this value sets to show sum of all core usages;

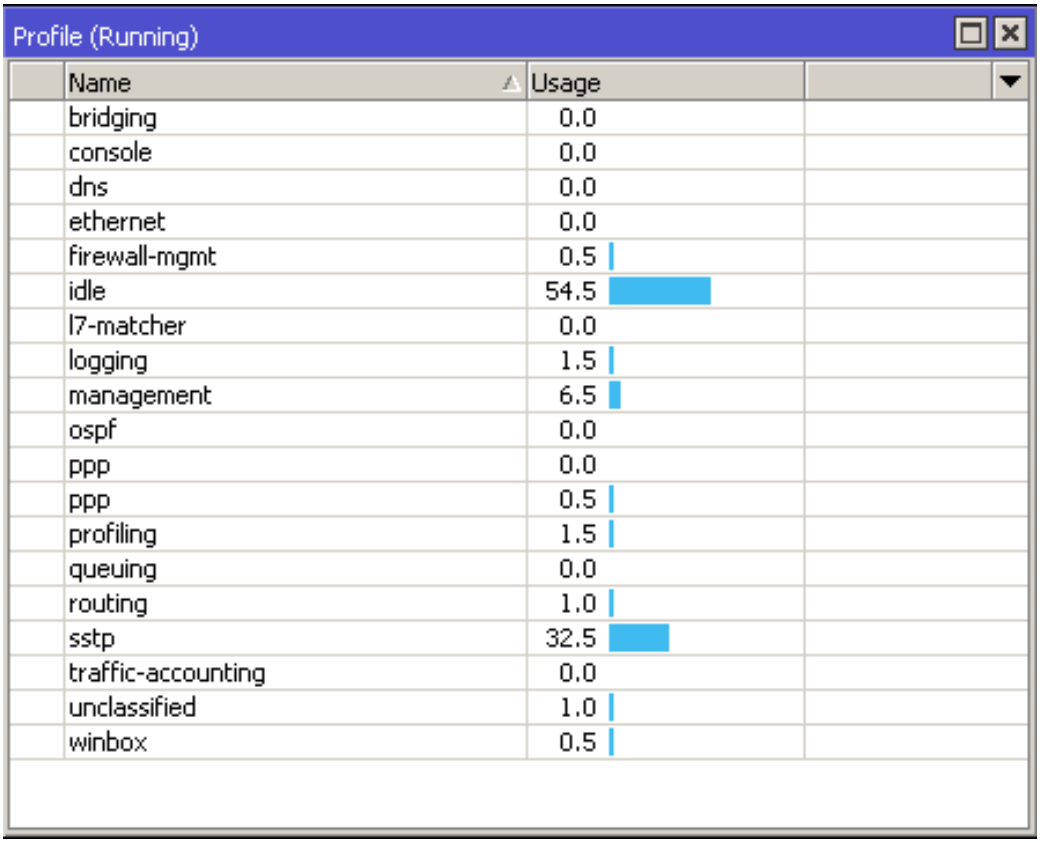
- all - value sets to show cpu usages separately for every available core

Example with both values on two core system:

```
[admin@x86-test] > /tool profile cpu=all
NAME              CPU         USAGE
ethernet          1           0%
kvm               0           0%
kvm               1           4.5%
management        0           0%
management        1           0.5%
idle              0           100%
idle              1           93%
profiling         0           0%
profiling         1           2%

[admin@x86-test] > /tool profile cpu=total
NAME              CPU         USAGE
ethernet          all         0%
console           all         0%
kvm               all         2.7%
management        all         0%
idle              all         97.2%
profiling         all         0%
bridging          all         0%
```

Tool is also available in winbox:



Classifiers

Profile classifies processes in several classifiers. Most of them are self explanatory and does not require detailed explanation.

- **idle** - shows unused CPU. Typically idle=100%-(sum of all process cpu usages).
- **ppp**
- **pppoe**
- **ppp-compression**
- **ppp-mppe**
- **ethernet** - cpu used by ethernets when sending/receiving packets
- **bridging**
- **encrypting** - cpu used by packet encryption
- **ipsec** - IP security
- **queuing** - packet queuing
- **firewall** - packet processing in Ip firewall
- **l7-matcher** - cpu used by Layer7 matcher.
- **p2p-matcher** - Peer-to-peer traffic matcher in ip firewall
- **gre** - Gre tunnels
- **eoip** - EoIP tunnels
- **m3p** - MikroTik Packet Packer Protocol
- **radius**
- **ip-pool**
- **routing**
- **sniffing**
- **traffic-accounting**
- **traffic-flow**
- **console**
- **telnet**
- **ssh**
- **ftp**
- **tfpt**
- **www**
- **dns**
- **snmp**
- **socks**
- **web-proxy**
- **winbox**
- **metarouter-fs**
- **metarouter-net**
- **kvm**
- **profiling** - cpu used by Profiler tool itself
- **btest** - bandwidth test tool
- **logging**
- **flash** - cpu usage when writing to NAND
- **disk** - cpu usage when wiring to Disk
- **serial**
- **usb**
- **firewall-mgmt**

- **queue-mgmt**
- **e-mail**
- **fetcher**
- **backup**
- **graphing**
- **health**
- **isdn**
- **dhcp**
- **hotspot**
- **radv** - IPv6 route advertisement
- **ntp** - NTP server/client
- **ldp**
- **mpls**
- **pim** - Multicast routing protocol
- **igmp-proxy**
- **bgp**
- **ospf**
- **rip**
- **mme**
- **synchronous** - cpu usage by synchronous cards
- **gps**
- **user-manager**
- **wireless**
- **dude**
- **supout.rif** - cpu used by supout.rif file creator.
- **management** - RouterOS management processes that do not fall into any other classifier. For example, when routes added to kernel, internal messaging exchange between RouterOS applications, etc.
- **unclassified** - any other processes that were not classified.

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Manual:Tools/Packet Sniffer

Applies to RouterOS: v5.8+

Summary

Sub-menu: `/tool sniffer`

Packages required: `system`

Packet sniffer is a tool that can capture and analyze packets that are going to, leaving or going through the router (except the traffic that passes only through the switch chip).

Packet Sniffer Configuration

Sub-menu: `/tool sniffer`

Property**`file-limit`** (*integer 10..4294967295[KiB]*; Default: **1000KiB**)**`file-name`** (*string*; Default:)**`filter-ip-address`** (*ip/mask[,ip/mask] (max 16 items)*; Default:)**`filter-mac-address`** (*mac/mask[,mac/mask] (max 16 items)*; Default:)**`filter-port`** (*[!]port[,port] (max 16 items)*; Default:)**`filter-ip-protocol`** (*[!]protocol[,protocol] (max 16 items)*; Default:)**`filter-mac-protocol`** (*[!]protocol[,protocol] (max 16 items)*; Default:)**`filter-stream`** (*yes* | *no*; Default: **yes**)**`filter-direction`** (*any* | *rx* | *tx*; Default:)**`interface`** (*all* | *name*; Default: **all**)**`memory-limit`** (*integer 10..4294967295[KiB]*; Default: **100KiB**)**`memory-scroll`** (*yes* | *no*; Default: **yes**)**`only-headers`** (*yes* | *no*; Default: **no**)**`streaming-enabled`** (*yes* | *no*; Default: **no**)**`streaming-server`** (*IP*; Default: **0.0.0.0**)DescriptionFile size limit. Sniffer will stop when limit is reached.Name of the file where sniffed packets will be saved.Up to 16 ip addresses used as a filterUp to 16 MAC addresses and MAC address masks used as a filterUp to 16 comma separated entries used as a filterUp to 16 comma separated entries used as a filter IP protocols (instead of protocol names, protocol number can be used)

- **ipsec-ah** - IPsec AH protocol
- **ipsec-esp** - IPsec ESP protocol
- **ddp** - datagram delivery protocol
- **egp** - exterior gateway protocol
- **ggp** - gateway-gateway protocol
- **gre** - general routing encapsulation
- **hmp** - host monitoring protocol
- **idpr-cmtp** - idpr control message transport
- **icmp** - internet control message protocol
- **icmpv6** - internet control message protocol v6
- **igmp** - internet group management protocol
- **ipencap** - ip encapsulated in ip
- **ipip** - ip encapsulation
- **encap** - ip encapsulation
- **iso-tp4** - iso transport protocol class 4
- **ospf** - open shortest path first
- **pup** - parc universal packet protocol

- **pim** - protocol independent multicast
- **rspf** - radio shortest path first
- **rdp** - reliable datagram protocol
- **st** - st datagram mode
- **tcp** - transmission control protocol
- **udp** - user datagram protocol
- **vmtp** - versatile message transport
- **vrrp** - virtual router redundancy protocol
- **xns-idp** - xerox xns idp
- **xtp** - xpress transfer protocol

Up to 16 comma separated entries used as a filter. Mac protocols (instead of protocol names, protocol number can be used):

- **arp** - Address Resolution Protocol
- **ip** - Internet Protocol
- **ipv6** - Internet Protocol next generation
- **ipx** - Internetwork Packet Exchange
- **rarp** - Reverse Address Resolution Protocol

Sniffed packets that are devised for sniffer server are ignoredSpecifies om which direction filtering will be applied.Interface name on which sniffer will be running. **all** indicates that sniffer will sniff packets on all interfaces.Memory amount used to store sniffed data.Whether to rewrite older sniffed data when memory limit is reached.Save in the memory only packet's headers not the whole packet.Defines whether to send sniffed packets to streaming serverTazmen Sniffer Protocol (TZSP) stream receiver

Example

In the following example **streaming-server** will be added, streaming will be enabled, **file-name** will be set to test and packet sniffer will be started and stopped after some time:

```
[admin@MikroTik] tool sniffer> set streaming-server=192.168.0.240 \
\... streaming-enabled=yes file-name=test.pcap
[admin@MikroTik] tool sniffer> print
            interface: all
         only-headers: no
         memory-limit: 100KiB
        memory-scroll: yes
            file-name: test.pcap
           file-limit: 1000KiB
    streaming-enabled: yes
     streaming-server: 192.168.0.240
        filter-stream: yes
   filter-mac-address:
  filter-mac-protocol:
    filter-ip-address:
   filter-ip-protocol:
          filter-port:
     filter-direction: any
              running: no
[admin@MikroTik] tool sniffer> start
```

```
[admin@MikroTik] tool sniffer> stop
```

Running Packet Sniffer

Commands: `/tool sniffer start, /tool sniffer stop, /tool sniffer save`

The commands are used to control runtime operation of the packet sniffer. The **start** command is used to start/reset sniffering, **stop** - stops sniffering. To save currently sniffed packets in a specific file **save** command is used.

It is also possible to use quick mode.

Example

In the following example the packet sniffer will be started and after some time - stopped:

```
[admin@MikroTik] tool sniffer> start
[admin@MikroTik] tool sniffer> stop
```

Below the sniffed packets will be saved in the file named test:

```
[admin@MikroTik] tool sniffer> save file-name=test
[admin@MikroTik] tool sniffer> /file print
  # NAME                            TYPE         SIZE       CREATION-TIME
  0 test                            unknown      1350       apr/07/2003 16:01:52
[admin@MikroTik] tool sniffer>
```

Sniffed Packets

Sub-menu: `/tool sniffer packet`

This sub-menu allows to see the list of sniffed packets.

```
[admin@SXT test] /tool sniffer packet> print
 #    TIME INTERFACE SRC-ADDRESS                                DST-ADDRESS
120   1.993 ether1    10.5.101.1:646                            224.0.0.2:646                          >
121   2.045 ether1    10.5.101.15:8291 (winbox)                 10.5.101.10:36771                      >
122   2.046 ether1    10.5.101.15:8291 (winbox)                 10.5.101.10:36771                      >
123   2.255 ether1    fe80::20c:42ff:fe49:fcec                  ff02::5                                >
```

Property	Description
data (*read-only: text*)	Specified data inclusion in packets
direction (*read-only: in | out*)	Indicates whether packet is entering (**in**) or leaving (**out**) the router
dscp (*read-only: integer*)	IP DSCP field value
dst-address (*read-only: IP address*)	Destination IP address
fragment-offset (*read-only: integer*)	IP fragment offset
identification (*read-only: integer*)	IP identification
interface (*read-only: name*)	Name of the interface the packet has been captured on
ip-header-size (*read-only: integer*)	The size of IP header
ip-packet-size (*read-only: integer*)	The size of IP packet

ip-protocol (*read-only: ddp | egp | encap | ggp | gre | hmp | icmp | icmpv6 | dpr-cmt | igmp | ip | ipencap | ipip | ipsec-ah | ipsec-esp | iso-tp4 | ospf | pim | pup | rdp | rspft | st | tcp | udp | vmtp | vrrp | xns-idp | xtp*)	The name/number of IP protocol
protocol (*read-only: ip | arp | rarp | ipx | ipv6*)	The name/number of ethernet protocol
size (*read-only: integer*)	Size of packet
src-address (*read-only: IP address*)	Source IP address
src-mac (*read-only: MAC address*)	Source MAC address
data (*read-only: string*)	IP data
tcp-flags (*read-only: ack | cwr | ece | fin | psh | rst | syn | urg*)	TCP flags
time (*read-only: time*)	Time when packet arrived
ttl (*read-only: integer*)	IP Time To Live
vlan-id (*read-only: integer*)	VLAN-ID of the packet
vlan-priority (*read-only: integer*)	VLAN-Priority of the packet

Packet Sniffer Protocols

Sub-menu: `/tool sniffer protocol`

In this submenu you can see all sniffed protocols and their share of the whole sniffed amount.

```
[admin@SXT test] /tool sniffer protocol> print
 # PROTOCOL IP-PROTOCOL PORT                                    PACKETS       BYTES         SHARE
 0 802.2                                                            1          60         0.05%
 1 ip                                                             215      100377        99.04%
 2 arp                                                              2         120         0.11%
 3 ipv6                                                             6         788         0.77%
 4 ip       tcp                                                   210       99981        98.65%
 5 ip       udp                                                     3         228         0.22%
 6 ip       ospf                                                    2         168         0.16%
 7 ip       tcp         8291 (winbox)                             210       99981        98.65%
 8 ip       tcp         36771                                     210       99981        98.65%
 9 ip       udp         646                                         3         228         0.22%
```

Property	Description
bytes (*read-only: integer*)	Total number of data bytes
ip-protocol (*read-only: ddp | egp | encap | ggp | gre | hmp | icmp | icmpv6 | dpr-cmt | igmp | ip | ipencap | ipip | ipsec-ah | ipsec-esp | iso-tp4 | ospf | pim | pup | rdp | rspft | st | tcp | udp | vmtp | vrrp | xns-idp | xtp*)	IP protocol
packets (*read-only: integer*)	The number of packets
port (*read-only: integer*)	The port of TCP/UDP protocol
protocol (*read-only: ip | arp | rarp | ipx | ipv6*)	The name/number of the protocol
share (*read-only: decimal*)	Specific type of traffic compared to all traffic in bytes

Packet Sniffer Host

Sub-menu: `/tool sniffer host`

The submenu shows the list of hosts that were participating in data excange you've sniffed.

```
[admin@SXT test] /tool sniffer host> print
 # ADDRESS         RATE                PEEK-RATE           TOTAL
 0 10.5.101.3      0bps/0bps           0bps/720bps         0/90
 1 10.5.101.10     0bps/0bps           175.0kbps/19.7kbps  61231/7011
 2 10.5.101.13     0bps/0bps           0bps/608bps         0/76
 3 10.5.101.14     0bps/0bps           0bps/976bps         0/212
 4 10.5.101.15     0bps/0bps           19.7kbps/175.0kbps  7011/61231
 5 224.0.0.2       0bps/0bps           608bps/0bps         76/0
 6 224.0.0.5       0bps/0bps           1440bps/0bps        302/0
[admin@SXT test] /tool sniffer host>
```

Property	Description
address (*read-only: IP address*)	IP address of the host
peek-rate (*read-only: integer/integer*)	The maximum data-rate received/transmitted
rate (*read-only: integer/integer*)	Current data-rate received/transmitted
total (*read-only: integer/integer*)	Total packets received/transmitted

Packet Sniffer Connections

Sub-menu: `/tool sniffer connection`

Here you can get a list of the connections that have been watched during the sniffing time.

```
[admin@MikroTik] tool sniffer connection> print
Flags: A - active
  #   SRC-ADDRESS       DST-ADDRESS             BYTES     RESENDS   MSS
  0 A 10.0.0.241:1839   10.0.0.181:23 (telnet)  6/42      60/0      0/0
  1 A 10.0.0.144:2265   10.0.0.181:22 (ssh)     504/252   504/0     0/0
[admin@MikroTik] tool sniffer connection>
```

Property	Description
active (*read-only: yes* | *no*)	Indicates whether connection is active or not
bytes (*read-only: integer/integer*)	Bytes in the current connection
dst-address (*read-only: IP address:port*)	Destination address
mss (*read-only: integer/integer*)	Maximum segment size
resends (*read-only: integer/integer*)	The number of packets resends in the current connection
src-address (*read-only: IP address:port*)	Source address

Quick mode

Quick mode will display results as they are filtered out with limited size buffer for packets. There are several attributes that can be set up filtering. If no attributes are set current configuration will be used.

Property**durationfreeze-frame-intervalinterfaceip-addressip-protocolmac-addressmac-protocolp** of the test in secondstime between data printoutintarface name or **all**up to 16 addresses to filter one of listed protocols, up to 16 entries

- **ipsec-ah** - IPsec AH protocol ***ipsec-esp** - IPsec ESP protocol
- **ddp** - datagram delivery protocol
- **egp** - exterior gateway protocol
- **ggp** - gateway-gateway protocol
- **gre** - general routing encapsulation
- **hmp** - host monitoring protocol
- **idpr-cmtp** - idpr control message transport
- **icmp** - internet control message protocol
- **icmpv6** - internet control message protocol v6
- **igmp** - internet group management protocol
- **ipencap** - ip encapsulated in ip
- **ipip** - ip encapsulation
- **encap** - ip encapsulation
- **iso-tp4** - iso transport protocol class 4
- **ospf** - open shortest path first
- **pup** - parc universal packet protocol
- **pim** - protocol independent multicast
- **rspf** - radio shortest path first
- **rdp** - reliable datagram protocol
- **st** - st datagram mode
- **tcp** - transmission control protocol
- **udp** - user datagram protocol
- **vmtp** - versatile message transport
- **vrrp** - virtual router redundancy protocol
- **xns-idp** - xerox xns idp
- **xtp** - xpress transfer protocol

up to 16 MAC addresses to filterup 16 entries

- **arp** - Address Resolution Protocol
- **ip** - Internet Protocol
- **ipv6** - Internet Protocol next generation
- **ipx** - Internetwork Packet Exchange
- **rarp** - Reverse Address Resolution Protocol

up to 16 entries to filter by

```
[admin@SXT test] /tool sniffer> quick interface=ether1
INTERFACE  TIME  NUM DI SRC-MAC           DST-MAC           VLAN SRC-ADDRESS
ether1    3.145  210 <- 00:24:1D:17:81:F7 00:0C:42:CB:DE:62      10.5.101.10:36771
ether1    3.145  211 -> 00:0C:42:CB:DE:62 00:24:1D:17:81:F7      10.5.101.15:8291 (winbox)
ether1    3.183  212 <- 00:24:1D:17:81:F7 00:0C:42:CB:DE:62      10.5.101.10:36771
ether1    3.184  213 -> 00:0C:42:CB:DE:62 00:24:1D:17:81:F7      10.5.101.15:8291 (winbox)
```

```
ether1    3.195  214 -> 00:0C:42:CB:DE:62 00:24:1D:17:81:F7      10.5.101.15:8291 (winbox)
ether1    3.195  215 -> 00:0C:42:CB:DE:62 00:24:1D:17:81:F7      10.5.101.15:8291 (winbox)
ether1    3.195  216 <- 00:24:1D:17:81:F7 00:0C:42:CB:DE:62      10.5.101.10:36771
ether1    3.217  217 <- 00:24:1D:17:81:F7 00:0C:42:CB:DE:62      10.5.101.10:36771
ether1    3.218  218 -> 00:0C:42:CB:DE:62 00:24:1D:17:81:F7      10.5.101.15:8291 (winbox)
ether1     3.22  219 <- 00:0C:42:49:FC:EC 33:33:00:00:00:05      fe80::20c:42ff:fe49:fcec
ether1    3.255  220 <- 00:0C:42:A1:6E:47 01:00:5E:00:00:05      192.168.15.6
ether1    3.256  221 <- 00:24:1D:17:81:F7 00:0C:42:CB:DE:62      10.5.101.10:36771
ether1    3.259  222 <- 00:24:1D:17:81:F7 00:0C:42:CB:DE:62      10.5.101.10:36771
ether1    3.294  223 -> 00:0C:42:CB:DE:62 00:24:1D:17:81:F7      10.5.101.15:8291 (winbox)
ether1    3.325  224 -> 00:0C:42:CB:DE:62 00:24:1D:17:81:F7      10.5.101.15:8291 (winbox)
ether1    3.325  225 -> 00:0C:42:CB:DE:62 00:24:1D:17:81:F7      10.5.101.15:8291 (winbox)
ether1    3.326  226 <- 00:24:1D:17:81:F7 00:0C:42:CB:DE:62      10.5.101.10:36771
ether1     3.35  227 <- 00:0C:42:A8:ED:C2 33:33:00:00:00:01      fe80::20c:42ff:fea8:edc2
ether1    3.391  228 <- 00:24:1D:17:81:F7 00:0C:42:CB:DE:62      10.5.101.10:36771
ether1    3.392  229 -> 00:0C:42:CB:DE:62 00:24:1D:17:81:F7      10.5.101.15:8291 (winbox)
```

Download Sniffer Results

Sub-menu: `/tool sniffer`

Packet Sniffer results could be downloaded and viewed as file by specific program (for example Wireshark [1]).

Property	Description
file-name (*string*; Default: "")	The name of the file where the sniffed packets will be saved to

To save sniffed result to file set,

```
[admin@MikroTik] /tool sniffer set file-name=example
```

Run sniffer with required settings,

```
[admin@MikroTik] /tool sniffer start
```

Do not forget to stop sniffer after sniffing is done,

```
[admin@MikroTik] /tool sniffer stop
```

Sniffed results could be downloaded from /file by FTP client or Windows Drag-n-Drop (do not forget to use **binary** mode, when file is downloaded by FTP).

```
[admin@MikroTik] /file print
 # NAME               TYPE             SIZE                 CREATION-TIME
 0 example            file             44092                jan/02/2010 01:11:59
```

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References

[1] http://www.wireshark.org/

Manual:Troubleshooting tools

Troubleshooting tools

Before, we look at the most significant commands for connectivity checking and troubleshooting, here is little reminder on how to check host computer's network interface parameters on .

The Microsoft windows have a whole set of helpful command line tools that helps testing and configuring LAN/WAN interfaces. We will look only at commonly used Windows networking tools and commands.

All of the tools are being ran from windows terminal. Go to ***Start/Run*** and enter "cmd" to open a Command window.

Some of commands on windows are:

ipconfig – used to display the TCP/IP network configuration values. To open it, enter "`ipconfig`" in the command prompt.

```
C:\>ipconfig
Windows IP Configuration
Ethernet adapter Local Area Connection:
   Connection-specific DNS Suffix  . : mshome.net
   Link-local IPv6 Address . . . . . : fe80::58ad:cd3f:f3df:bf18%8
   IPv4 Address. . . . . . . . . . . : 173.16.16.243
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : 173.16.16.1
```

There are also a variety of additional functions for *ipconfig*. To obtain a list of additional options, enter "`ipconfig /?`" or "`ipconfig –?`".

netstat – displays the active TCP connections and ports on which the computer is listening, Ethernet statistics, the IP routing table, statistics for the IP, ICMP, TCP, and UDP protocols. It comes with a number of options for displaying a variety of properties of the network and TCP connections "netstat –?".

nslookup – is a command-line administrative tool for testing and troubleshooting DNS servers. For example, if you want to know what IP address is "www.google.com", enter "*nslookup www.google.com*" and you will find that there are more addresses 74.125.77.99, 74.125.77.104, 74.125.77.147.

netsh – is a tool an administrator can use to configure and monitor Windows-based computers at a command prompt. It allows configure interfaces, routing protocols, routes, routing filters and display currently running configuration.

Very similar commands are available also on unix-like machines. Today in most of Linux distributions network settings can be managed via GUI, but it is always good to be familiar with the command-line tools. Here is the list of basic networking commands and tools on Linux:

ifconfig – it is similar like *ipconfig* commands on windows. It lets enable/disable network adapters, assigned IP address and netmask details as well as show currently network interface configuration.

iwconfig - iwconfig tool is like ifconfig and ethtool for wireless cards. That also view and set the basic Wi-Fi network details.

nslookup – give a host name and the command will return IP address.

netstat – print network connections, including port connections, routing tables, interface statistics, masquerade connections, and more. (*netstat – r, netstat - a*)

ip – show/manipulate routing, devices, policy routing and tunnels on linux-machine.

For example, check IP address on interface using *ip* command:

```
$ip addr show
```

You can add static route using *ip* following command:

ip route add {NETWORK address} via {next hop address} dev {DEVICE}, for example:

```
$ip route add 192.168.55.0/24 via 192.168.1.254 dev eth1
```

mentioned tools are only small part of networking tools that is available on Linux. Remember if you want full details on the tools and commands options use ***man*** command. For example, if you want to know all options on ***ifconfig*** write command ***man ifconfig*** in terminal.

Check network connectivity

Using the *ping* command

Ping is one of the most commonly used and known commands. Administration utility used to test whether a particular host is reachable across an Internet Protocol (IP) network and to measure the round-trip time for packets sent from the local host to a destination host, including the local host's own interfaces.

Ping uses Internet Control Message Protocol (ICMP) protocol for echo response and echo request. Ping sends ICMP *echo* request packets to the target host and waits for an ICMP response. Ping output displays the minimum, average and maximum times used for a ping packet to find a specified system and return.

From PC:

Windows:

```
C:\>ping 10.255.255.4
 Pinging 10.255.255.4 with 32 bytes of data:
Reply from 10.255.255.4: bytes=32 time=1ms TTL=61
Reply from 10.255.255.4: bytes=32 time<1ms TTL=61
Reply from 10.255.255.4: bytes=32 time<1ms TTL=61
Reply from 10.255.255.4: bytes=32 time<1ms TTL=61
Ping statistics for 10.255.255.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0%
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

Unix-like:

```
andris@andris-desktop:/$ ping 10.255.255.6
PING 10.255.255.6 (10.255.255.6) 56(84) bytes of data.
64 bytes from 10.255.255.6: icmp_seq=1 ttl=61 time=1.23 ms
64 bytes from 10.255.255.6: icmp_seq=2 ttl=61 time=0.904 ms
64 bytes from 10.255.255.6: icmp_seq=3 ttl=61 time=0.780 ms
64 bytes from 10.255.255.6: icmp_seq=4 ttl=61 time=0.879 ms
^C
--- 10.255.255.6 ping statistics ---
```

```
4 packets transmitted, 4 received, 0% packet loss, time 2999ms
rtt min/avg/max/mdev = 0.780/0.948/1.232/0.174 ms
```

Press Ctrl-C to stop ping process.

From MikroTik:

```
[admin@MikroTik] > ping 10.255.255.4
10.255.255.4 64 byte ping: ttl=62 time=2 ms
10.255.255.4 64 byte ping: ttl=62 time=8 ms
10.255.255.4 64 byte ping: ttl=62 time=1 ms
10.255.255.4 64 byte ping: ttl=62 time=10 ms
4 packets transmitted, 4 packets received, 0% packet loss
round-trip min/avg/max = 1/5.2/10 ms
```

Press Ctrl-C to stop ping process.

Using the *traceroute* command

Traceroute displays the list of the routers that packet travels through to get to a remote host. The **traceroute** or **tracepath** tool is available on practically all Unix-like operating systems and **tracert** on Microsoft Windows operating systems.

Traceroute operation is based on TTL value and ICMP “Time Exceeded” massage. Remember that TTL value in IP header is used to avoid routing loops. Each hop decrements TTL value by 1. If the TTL reaches zero, the packet is discarded and ICMP Time Exceeded message is sent back to the sender when this occurs.

Initially by traceroute, the TTL value is set to 1 when next router finds a packet with TTL = 1 it sets TTL value to zero, and responds with an ICMP "time exceeded" message to the source. This message lets the source know that the packet traverses that particular router as a hop. Next time TTL value is incremented by 1 and so on. Typically, each router in the path towards the destination decrements the TTL field by one unit TTL reaches zero.

Using this command you can see how packets travel through the network and where it may fail or slow down. Using this information you can determine the computer, router, switch or other network device that possibly causing network issues or failures.

From Personal computer:

Windows:

```
C:\>tracert 10.255.255.2
Tracing route to 10.255.255.2 over a maximum of 30 hops
  1    <1 ms    <1 ms    <1 ms  10.13.13.1
  2     1 ms     1 ms     1 ms  10.255.255.2
Trace complete.
```

Unix-like:

Traceroute and *tracepath* is similar, only tracepath does not not require superuser privileges.

```
andris@andris-desktop:~$ tracepath 10.255.255.6
 1:  andris-desktop.local (192.168.10.4)                   0.123ms pmtu 1500
 1:  192.168.10.1 (192.168.10.1)                           0.542ms
 1:  192.168.10.1 (192.168.10.1)                           0.557ms
 2:  192.168.1.2 (192.168.1.2)                             1.213ms
 3:  no reply
 4:  10.255.255.6 (10.255.255.6)                           2.301ms reached
```

```
     Resume: pmtu 1500 hops 4 back 61
```

From MikroTik:

```
[admin@MikroTik] > tool traceroute 10.255.255.1
     ADDRESS                                  STATUS
   1       10.0.1.17 2ms 1ms 1ms
   2    10.255.255.1 5ms 1ms 1ms
[admin@MikroTik] >
```

Log Files

System event monitoring facility allows to debug different problems using Logs. Log file is a text file created in the server/router/host capturing different kind of activity on the device. This file is the primary data analysis source. RouterOS is capable of logging various system events and status information. Logs can be saved in routers memory (RAM), disk, file, sent by email or even sent to remote syslog server.

All messages stored in routers local memory can be printed from `/log` menu. Each entry contains time and date when event occurred, topics that this message belongs to and message itself.

```
[admin@MikroTik] /log> print
15:22:52 system,info device changed by admin
16:16:29 system,info,account user admin logged out from 10.13.13.14 via winbox
16:16:29 system,info,account user admin logged out from 10.13.13.14 via telnet
16:17:16 system,info filter rule added by admin
16:17:34 system,info mangle rule added by admin
16:17:52 system,info simple queue removed by admin
16:18:15 system,info OSPFv2 network added by admin
```

Read more about logging on RouterOS here>>

Torch (/tool torch)

Torch is realtime traffic monitoring tool that can be used to monitor the traffic flow through an interface.

You can monitor traffic classified by protocol name, source address, destination address, port. Torch shows the protocols you have chosen and tx/rx data rate for each of them.

Example:

The following example monitor the traffic generated by the telnet protocol, which passes through the interface ether1.

```
[admin@MikroTik] tool> torch ether1 port=telnet
SRC-PORT                    DST-PORT                    TX         RX
1439                        23 (telnet)                 1.7kbps    368bps

[admin@MikroTik] tool>
```

To see what IP protocols are sent via ether1:

```
[admin@MikroTik] tool> torch ether1 protocol=any-ip
PRO.. TX         RX
tcp   1.06kbps   608bps
udp   896bps     3.7kbps
```

```
 icmp  480bps     480bps
 ospf  0bps       192bps

 [admin@MikroTik] tool>
```

In order to see what protocols are linked to a host connected to interface 10.0.0.144/32 ether1:

```
 [admin@MikroTik] tool> torch ether1 src-address=10.0.0.144/32 protocol=any

  PRO.. SRC-ADDRESS     TX         RX
  tcp   10.0.0.144      1.01kbps   608bps
  icmp  10.0.0.144      480bps     480bps
 [admin@MikroTik] tool>
```

IPv6

Starting from v5RC6 torch is capable of showing IPv6 traffic. Two new parameters are introduced *src-address6* and *dst-address6*. Example:

```
admin@RB1100test] > /tool torch interface=bypass-bridge src-address6=::/0 ip-protocol=any sr
c-address=0.0.0.0/0
MAC-PROTOCOL    IP-PROT... SRC-ADDRESS                                TX         RX
ipv6            tcp        2001:111:2222:2::1                         60.1kbps   1005.4kbps
ip              tcp        10.5.101.38                                18.0kbps   3.5kbps
ip              vrrp       10.5.101.34                                0bps       288bps
ip              udp        10.5.101.1                                 0bps       304bps
ip              tcp        10.0.0.176                                 0bps       416bps
ip              ospf       224.0.0.5                                  544bps     0bps
                                                                      78.7kbps   1010.0kbps
```

To make */ping* tool to work with domain name that resolves IPv6 address use the following:

```
/ping [:resolve ipv6.google.com]
```

By default *ping* tool will take IPv4 address.

Winbox

More attractive Torch interface is available from Winbox (Tool>Torch). In Winbox you can also trigger a Filter bar by hitting the F key on the keyboard.

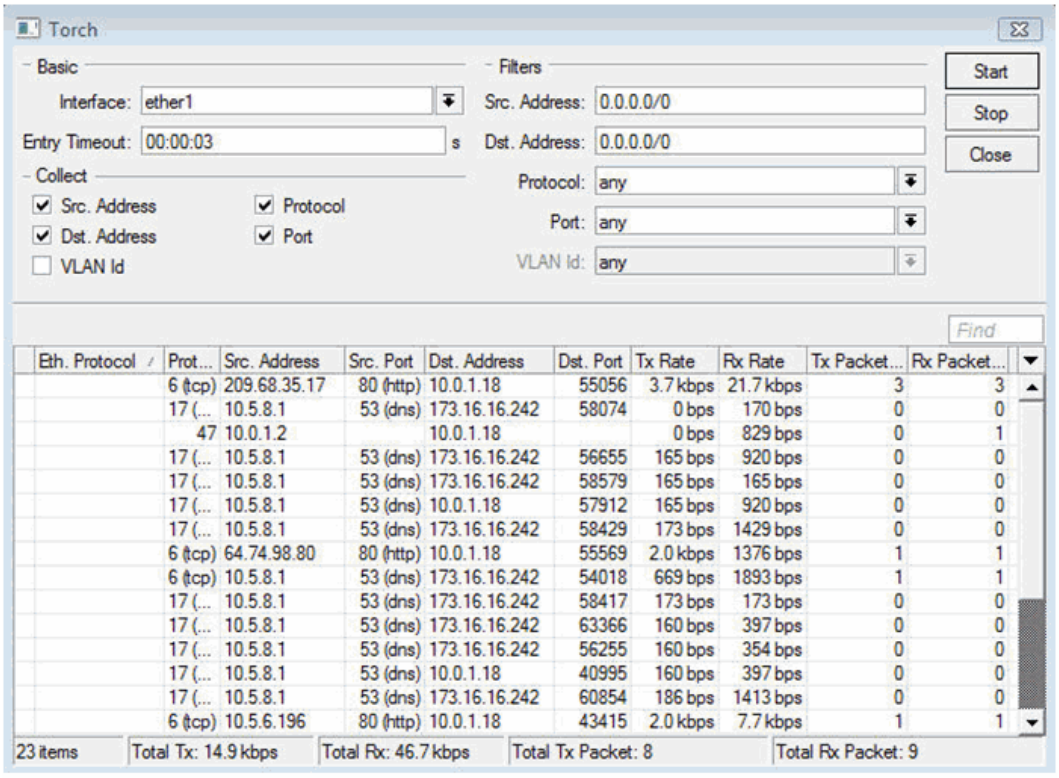


Figure 11.1 Torch tool GUI by winbox

Packet Sniffer (/tool sniffer)

Packet sniffer is a tool that can capture and analyze packets sent and received by specific interface. packet sniffer uses *libpcap* format.

Packet Sniffer Configuration

In the following example **streaming-server** will be added, streaming will be enabled, **file-name** will be set to test and packet sniffer will be started and stopped after some time:

```
[admin@MikroTik] tool sniffer> set streaming-server=192.168.0.240 \
\... streaming-enabled=yes file-name=test
[admin@MikroTik] tool sniffer> print
            interface: all
         only-headers: no
         memory-limit: 10
            file-name: "test"
           file-limit: 10
    streaming-enabled: yes
     streaming-server: 192.168.0.240
        filter-stream: yes
      filter-protocol: ip-only
      filter-address1: 0.0.0.0/0:0-65535
      filter-address2: 0.0.0.0/0:0-65535
```

```
               running: no
 [admin@MikroTik] tool sniffer> start
 [admin@MikroTik] tool sniffer> stop
```

Here you can specify different *packet sniffer* parameters, like maximum amount of used memory, file size limit in KBs.

Running Packet Sniffer Tool

There are three commands that are used to control runtime operation of the packet sniffer:

/tool sniffer start, ***/tool sniffer stop***, ***/tool sniffer save.***

The **start** command is used to start/reset sniffing, **stop** - stops sniffing. To save currently sniffed packets in a specific file **save** command is used.

```
In the following example the packet sniffer will be started and after some time - stopped:
```

```
 [admin@MikroTik] tool sniffer> start
 [admin@MikroTik] tool sniffer> stop
```

Below the sniffed packets will be saved in the file named *test*:

```
 [admin@MikroTik] tool sniffer> save file-name=test
```

View sniffed packets

There are also available different submenus for viewing sniffed packets.

- ***/tool sniffer packet – show*** the list of sniffed packets
- ***/tool sniffer protocol – show*** all kind of protocols that have been sniffed
- ***/tool sniffer host –*** shows the list of hosts that were participating in data exchange you've sniffed

For example:

```
 [admin@MikroTik] tool sniffer packet> print

  # TIME    INTERFACE   SRC-ADDRESS
  0 1.697    ether1    0.0.0.0:68 (bootpc)
  1 1.82     ether1    10.0.1.17
  2 2.007    ether1    10.0.1.18
  3 2.616    ether1    0.0.0.0:68 (bootpc)
  4 2.616    ether1    10.0.1.18:45630
  5 5.99     ether1    10.0.1.18
  6 6.057    ether1    159.148.42.138
  7 7.067    ether1    10.0.1.5:1701 (l2tp)
  8 8.087    ether1    10.0.1.18:1701 (l2tp)
  9 9.977    ether1    10.0.1.18:1701 (l2tp)
 -- more
```

Figure below shows sniffer GUI in Winbox, which is more user-friendly.

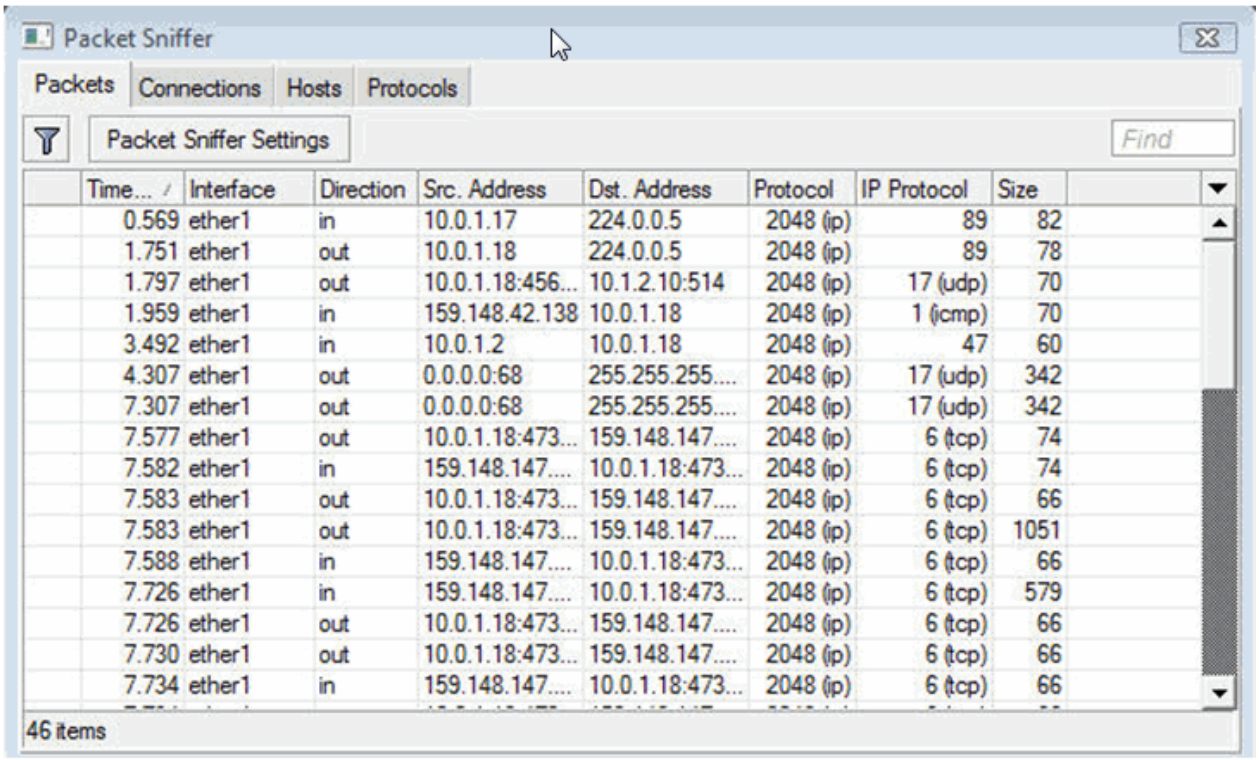


Figure 11.2 Packet Sniffer GUI by winbox

Detailed commands description can be found in the manual >>

Bandwidth test

The Bandwidth Tester can be used to measure the throughput (Mbps) to another MikroTik router (either wired or wireless network) and thereby help to discover network "*bottlenecks*"- network point with lowest throughput.

BW test uses two protocols to test bandwidth:

- TCP – uses the standard TCP protocol operation principles with all main components like connection initialization, packets acknowledgments, *congestion window* mechanism and all other features of TCP algorithm. Please review the TCP protocol for details on its internal speed settings and how to analyze its behavior. Statistics for throughput are calculated using the entire size of the TCP data stream. As acknowledgments are an internal working of TCP, their size and usage of the link are not included in the throughput statistics. Therefore statistics are not as reliable as the UDP statistics when estimating throughput.
- UDP traffic – sends 110% or more packets than currently reported as received on the other side of the link. To see the maximum throughput of a link, the packet size should be set for the maximum MTU allowed by the links which is usually 1500 bytes. There is no acknowledgment required by UDP; this implementation means that the closest approximation of the throughput can be seen.

Remember that *Bandwidth Test* uses all available bandwidth (by default) and may impact network usability.

If you want to test real throughput of a router, you should run bandwidth test through the router not from or to it. To do this you need at least 3 routers connected in chain:

Bandwidth Server – router under test – Bandwidth Client.

Note: If you use UDP protocol then Bandwidth Test counts IP header+UDP header+UDP data. In case if you use TCP then Bandwidth Test counts only TCP data (TCP header and IP header are not included).

Configuration example:

Server

To enable **bandwidth-test** server with client authentication:

```
[admin@MikroTik] /tool bandwidth-server> set enabled=yes authenticate=yes
[admin@MikroTik] /tool bandwidth-server> print
                  enabled: yes
             authenticate: yes
  allocate-udp-ports-from: 2000
             max-sessions: 100

[admin@MikroTik] /tool bandwidth-server>
```

Client

Run UDP bandwidth test in both directions, user name and password depends on remote Bandwidth Server. In this case user name is ‘admin’ without any password.

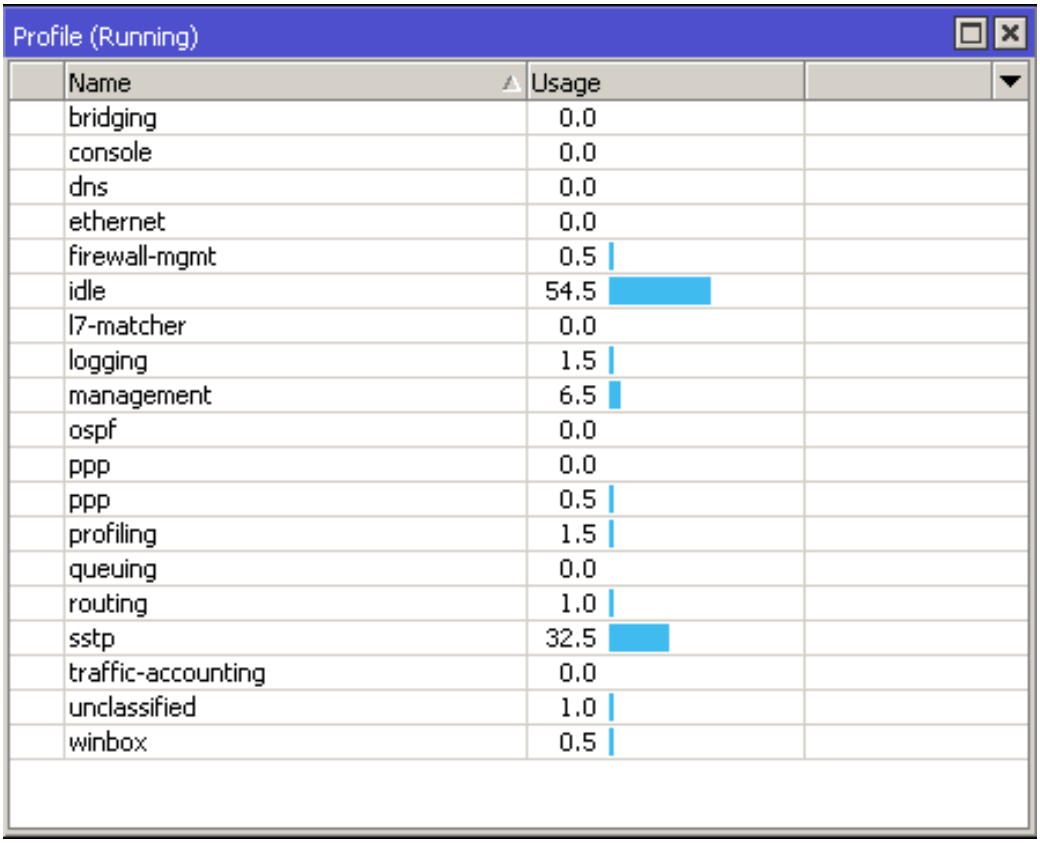
```
[admin@MikroTik] > tool bandwidth-test protocol=udp user=admin password="" direction=both \
address=10.0.1.5
                status: running
              duration: 22s
            tx-current: 97.0Mbps
  tx-10-second-average: 97.1Mbps
      tx-total-average: 75.2Mbps
            rx-current: 91.7Mbps
  rx-10-second-average: 91.8Mbps
      rx-total-average: 72.4Mbps
          lost-packets: 294
           random-data: no
             direction: both
               tx-size: 1500
               rx-size: 1500

-- [Q quit|D dump|C-z pause]
```

More information and all commands description can be found in the manual>>

Profiler

Profiler is a tool that shows CPU usage for each process running on RouterOS. It helps to identify which process is using most of the CPU resources.



Read more >>

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Manual:Grounding

Introduction

The installation infrastructure (towers and masts), as well as antennas and the router itself must be properly grounded, and lightning arrestors must be installed on all external antenna cables (near the antennas or on the antennas themselves) to prevent equipment damage and human injury. Note that lightning arrestors will not have any effect if not grounded.

Use 1 AWG (7mm in diameter) wire with corrosion-resistant connectors for grounding. Be sure to check that the grounding infrastructure you use is indeed functional (as opposed to decorative-only grounding present on some sites). For smaller devices you can use thinner wire.

1. Only shielded and outdoor usage Ethernet cables should be used, magnetic shield should be grounded via shielded RJ-45 connector or via additional wire that is soldered to RJ45 or ground wire.
2. Grounding wire should be connected to RouterBOARD (to the mounting point where board is fastened to the outdoor box), this wire is connected to bottom of the tower and connection to the tower is according to the standards. Antenna grounding wire is connected near RouterBOARD Outdoor case, this wire could be connected to the same RouterBOARD grounding wire.
3. Ethernet port ligthing protectors are not recommended, as most of them are not intended to use for PoE (they are shortening PoE supply). If protectors are used, they could be placed at the outdoor case, where RouterBOARD and grounding pads are connected.

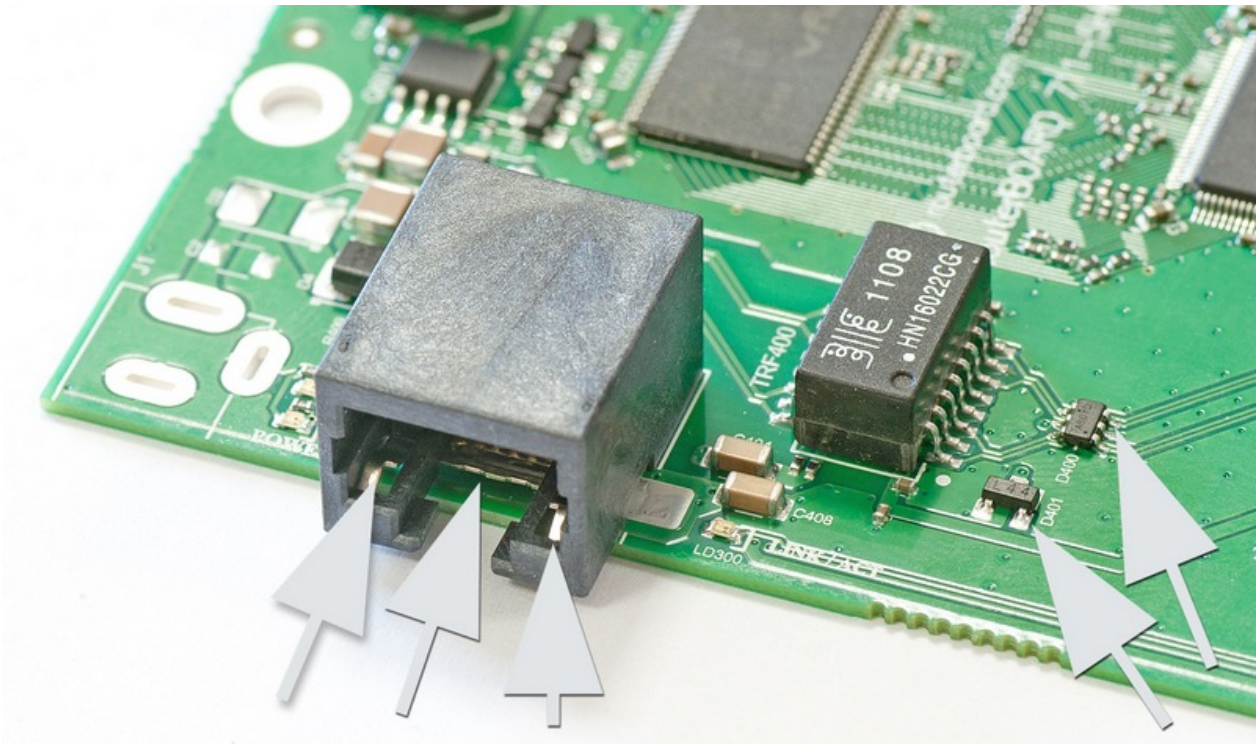
Shielded cable

Example grounding wire attachment screw on an outdoor case:

ESD Protection on RouterBOARD devices

1. Three arrows mark the grounding inside the ethernet port, the shielded cable connects it's shield to these two grounding pins via the metallic ethernet connector.
2. The middle arrow points to the metal plate inside the port, which connects the grounding pins to the board. The board needs to be grounded at the mounting hole (put grounding wire on the screw when you mount the board inside a case). Any surges will go from the grounding pins, to the grounding plate, to the board, and then to the grounding installation.
3. The two separate arrows show the ESD protection chips on the board - in case there was no shielded cable, to protect the CPU and other parts of the board.

The protection is not too effective if you only use shielded cable, and don't ground the board itself. You need to do both things to be successful. See below for possible methods, option 1 is recommended.



Grounding RouterBOARD installations

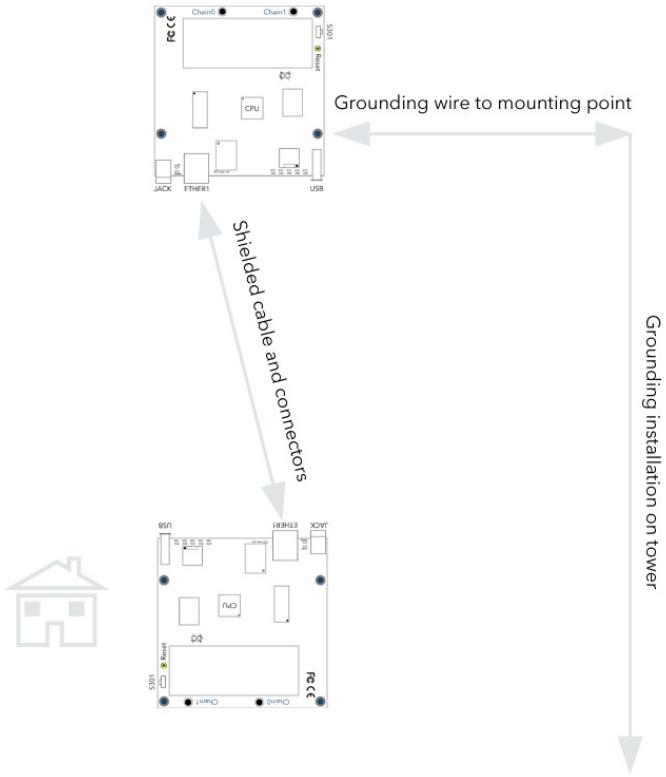
There are two methods, one of them more effective than the other.

1. **Using a Shielded cable + Board is grounded**: If you connect grounding to the mounting point of the RB711 (or the mounting loop inside SXT door), you don't necessary need to ground the device at other end of the shielded cable. Just using a shielded cable is enough. Special PoE is also not needed. This is the best option to protect against all ESD damage.
2. **Using only shielded cable**: If you can't ground the RB711/SXT/other device itself, you can ground the device on the other end of your shielded cable (switch, router, etc). If you need to use PoE, the injector with a metal shielding around connectors will be required, because it allows shielded cable to be used. This method is not recommended, better ground the board itself also (option 1).

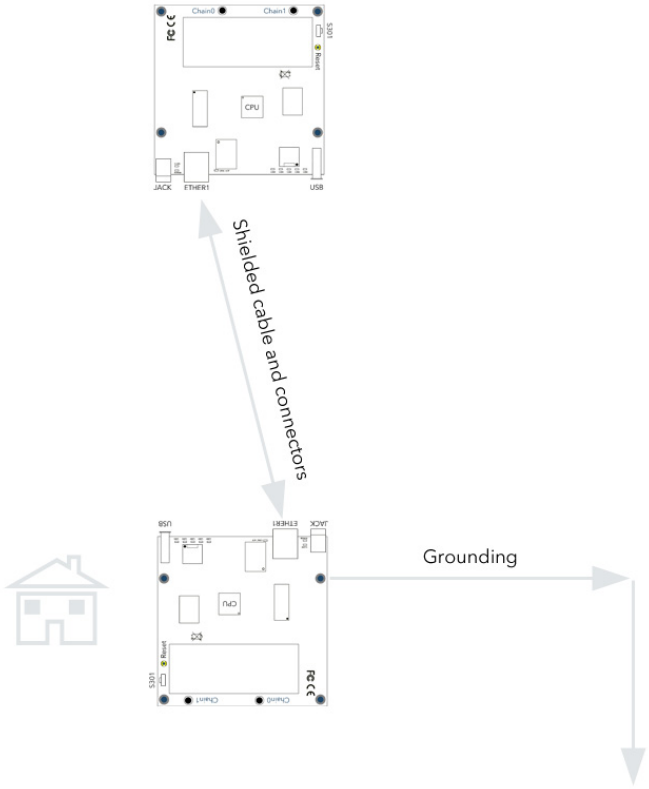
PoE with shielded connectors

Illustrations of the above methods

Method #1 (shielded cable + grounding of the device):



Method #2 (only shielded cable):



Note! Even if you don't ground the outdoor wireless device, and only use a shielded cable, you should still ground the device it's connected to (indoors). Ie. the switch, routerboard or PC.

Manual:Wireless card diagnostics

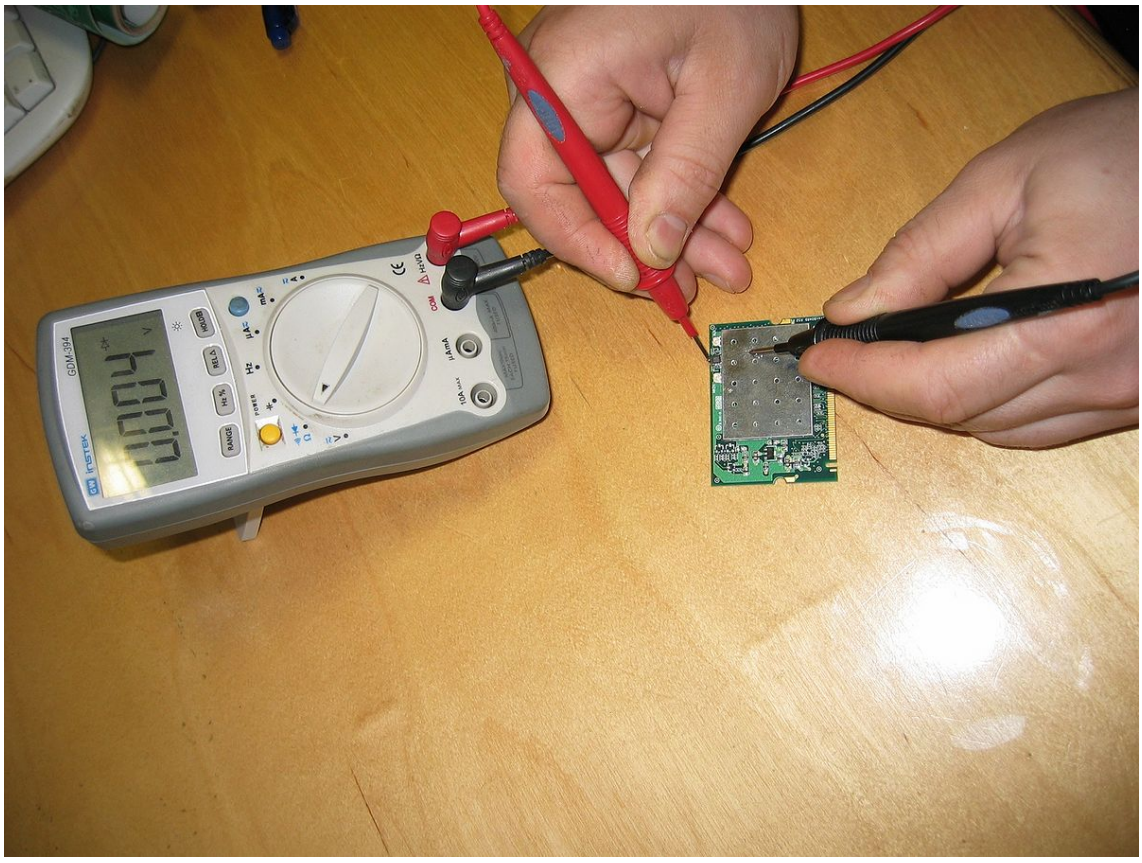
R52, R52Hn and R52H Power Amplifier damage

If the cards are becoming too hot to touch, when inserted in a RouterBOARD, but are disabled - the PA might be damaged. This could be caused by user, or by manufacturing problem. To determine, must return to RMA for close inspection.

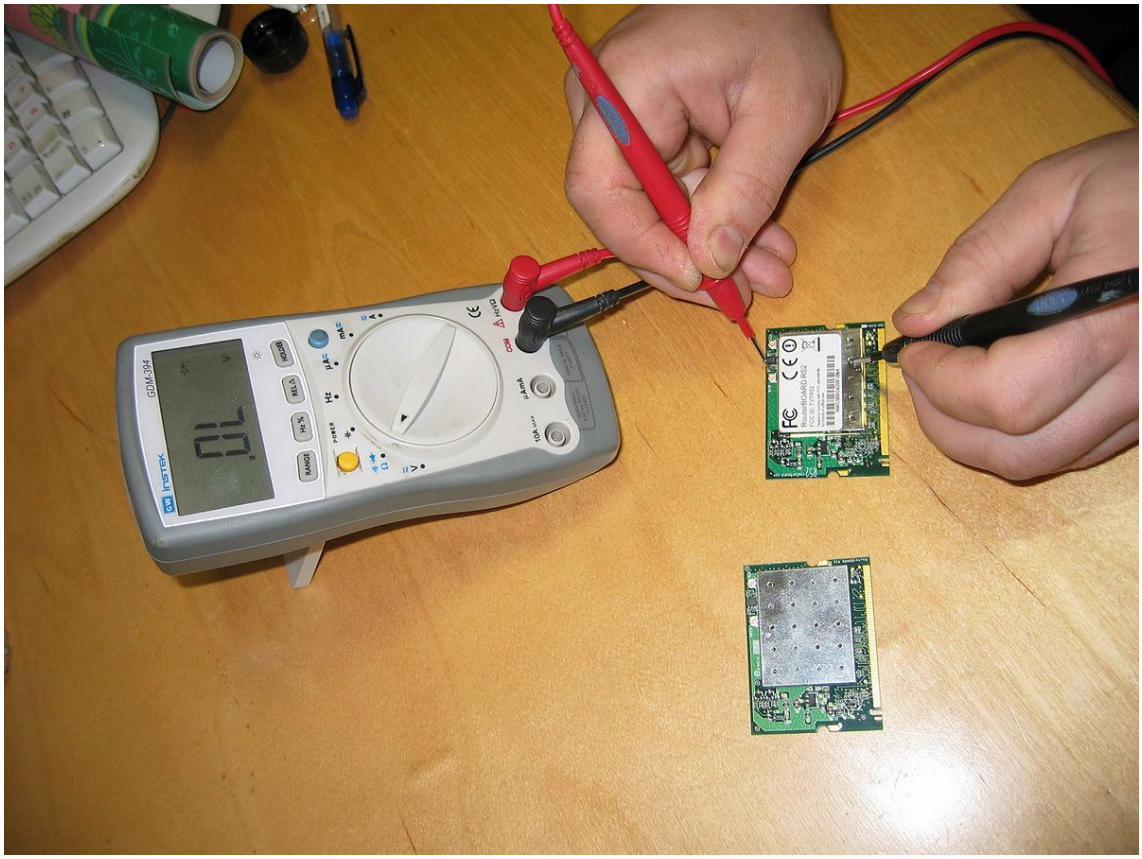
R52, R52Hn and R52H ESD damage

Improper grounding can cause ESD damage to wireless cards during storms or other ESD situations. To test if your R52 or R52H card is malfunctioning due to lightning/storm electrostatic damage, use a multimeter. In case the test fails with this method, the warranty doesn't cover it:

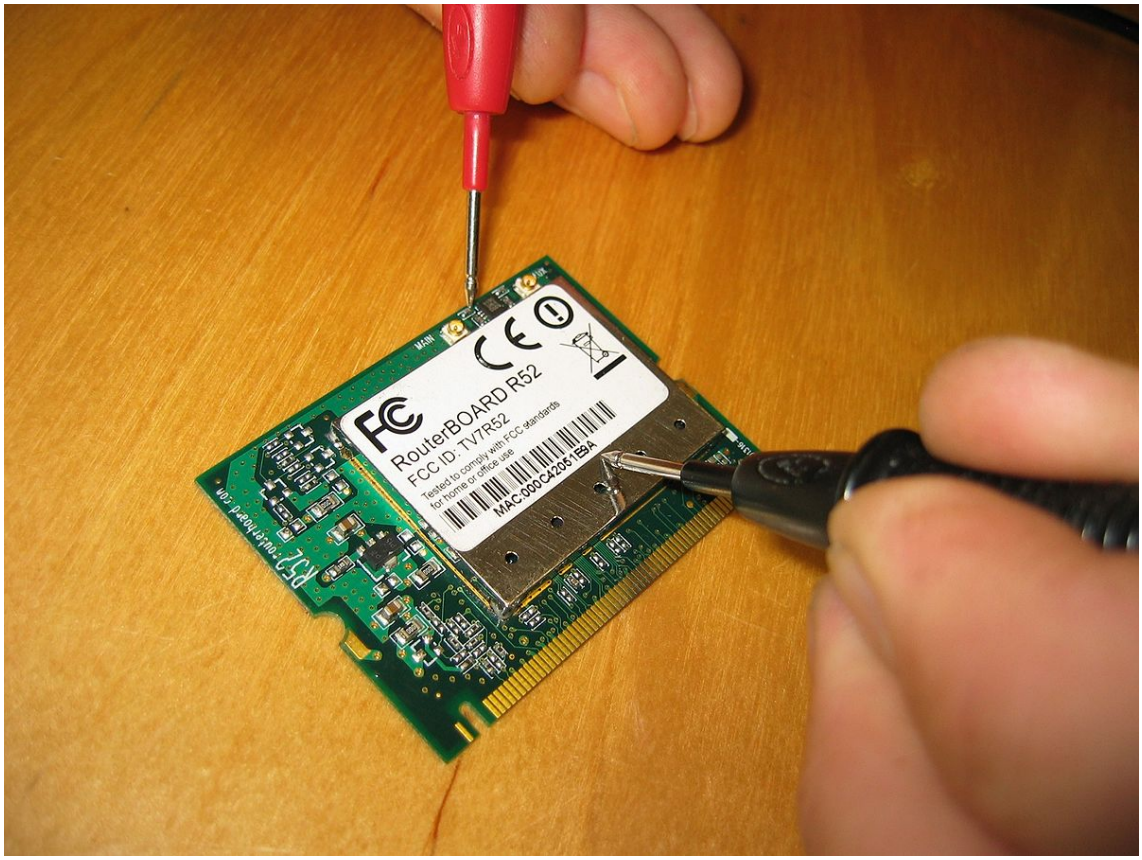
Damaged card:



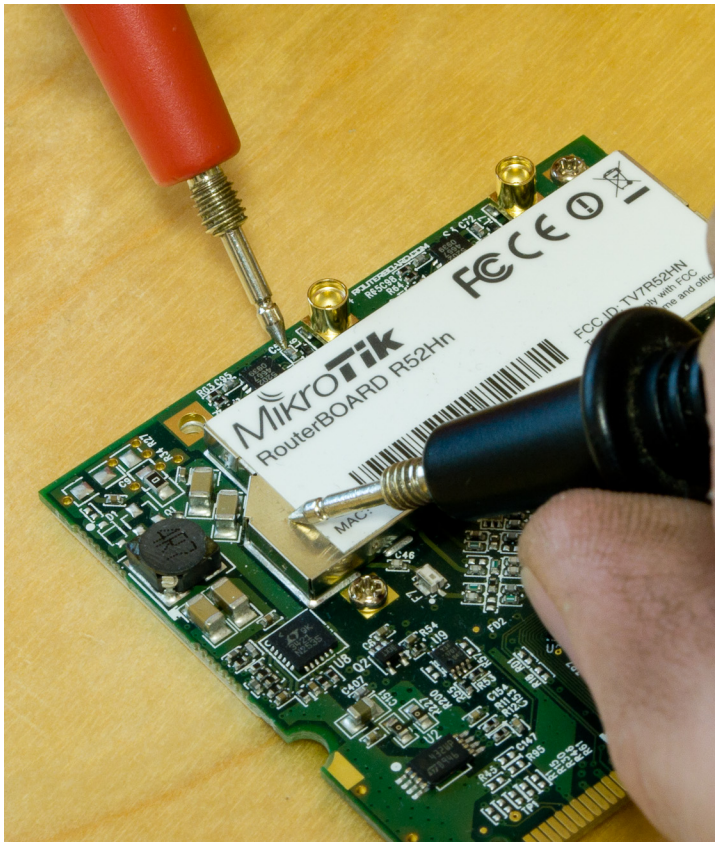
Normal card:



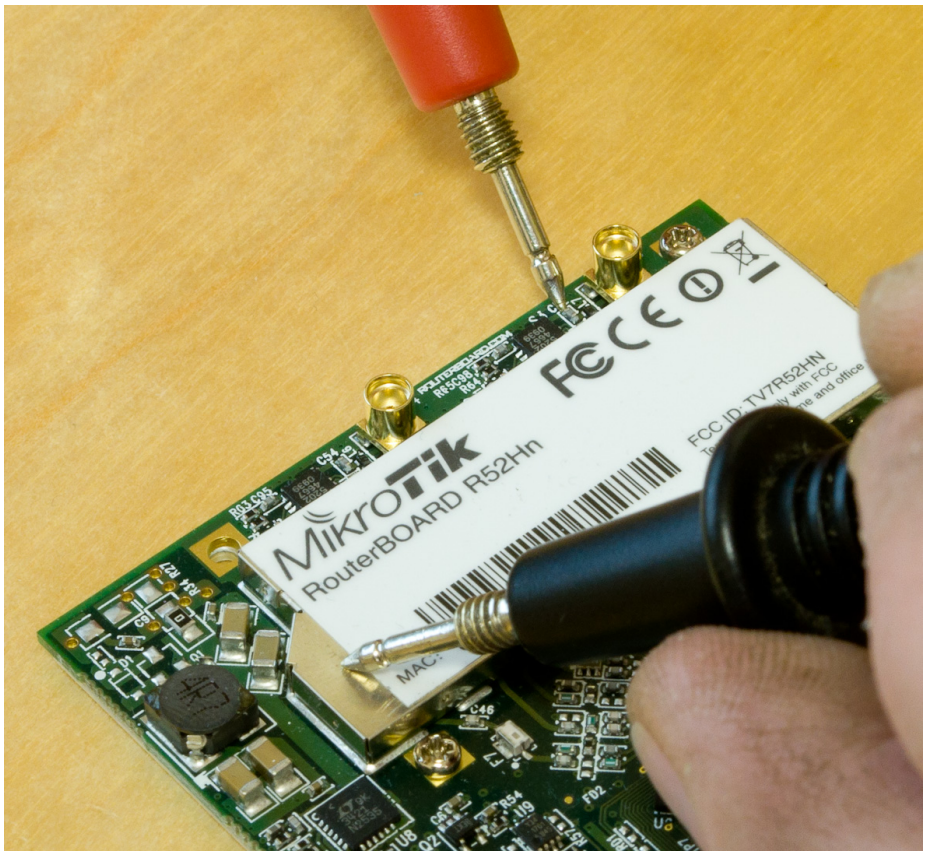
Testing area close-up:



R52Hn card chain 0:



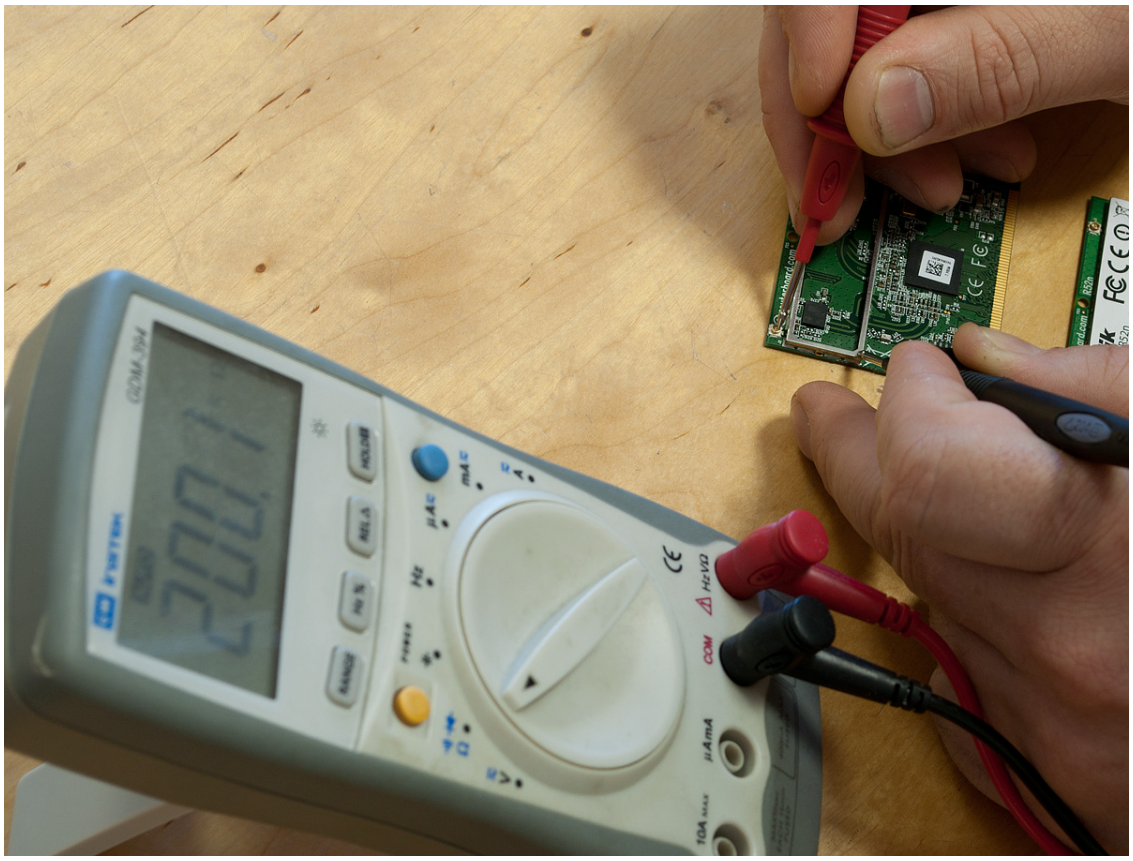
R52Hn chain 1:



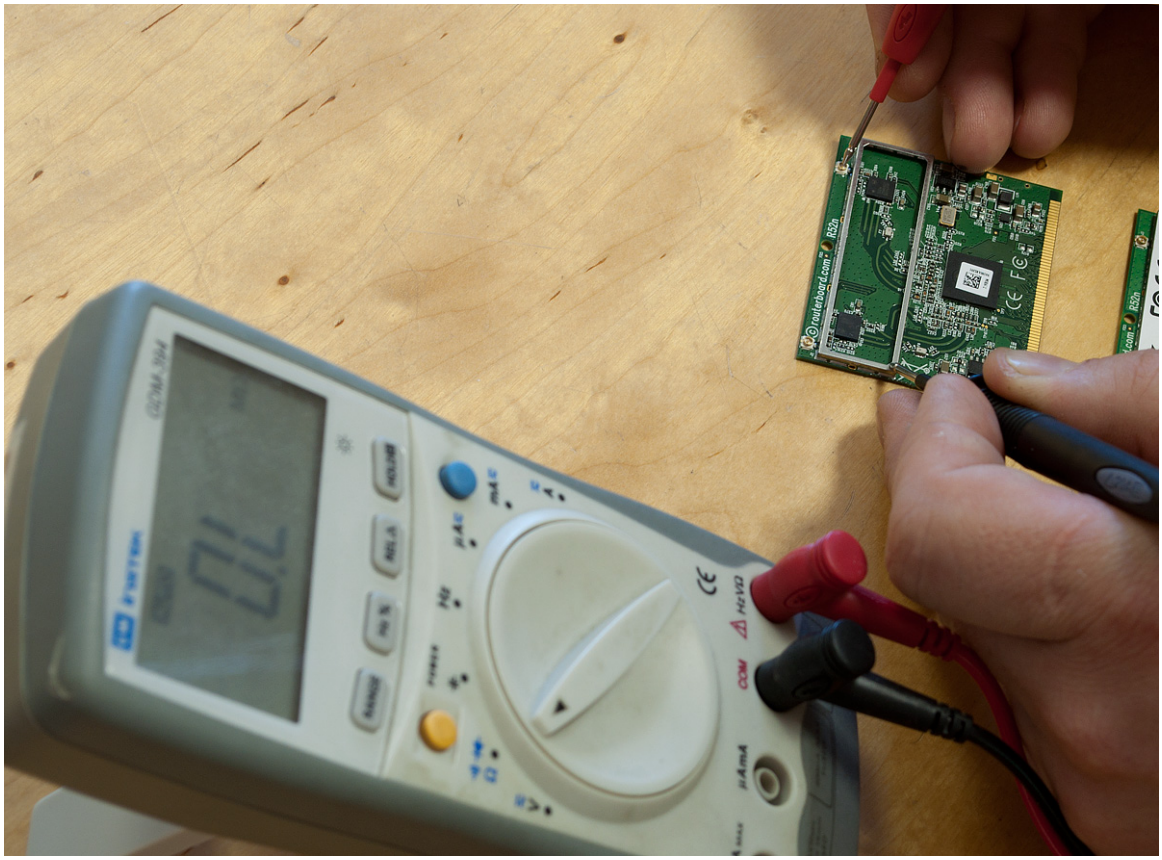
R52n antenna circuit damage test

These images show how to test for antenna circuit damage. If the resistance between shown points is lower than infinity (shown as OL on multimeter), the card is damaged by lightning, and the damage will not be repaired by warranty (don't send to RMA).

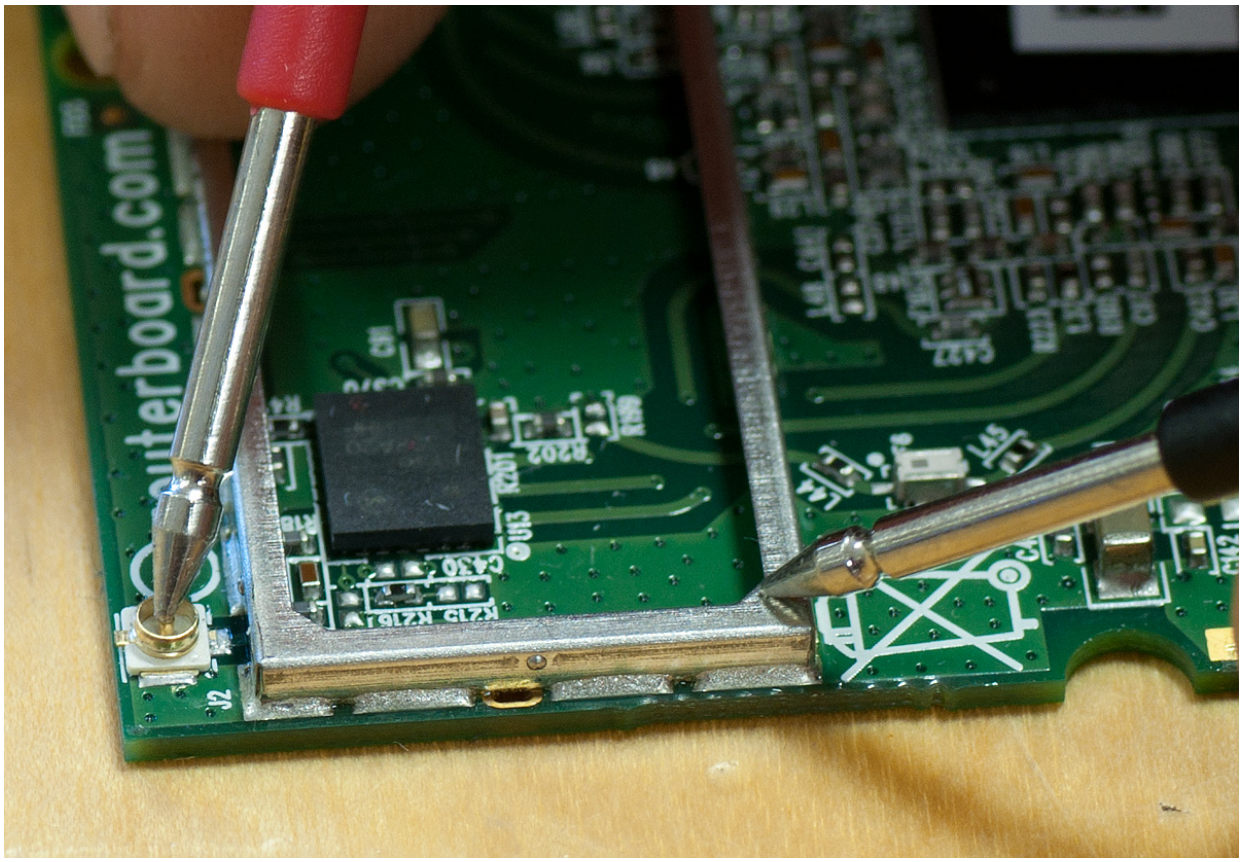
This chain is damaged:



This chain is OK:



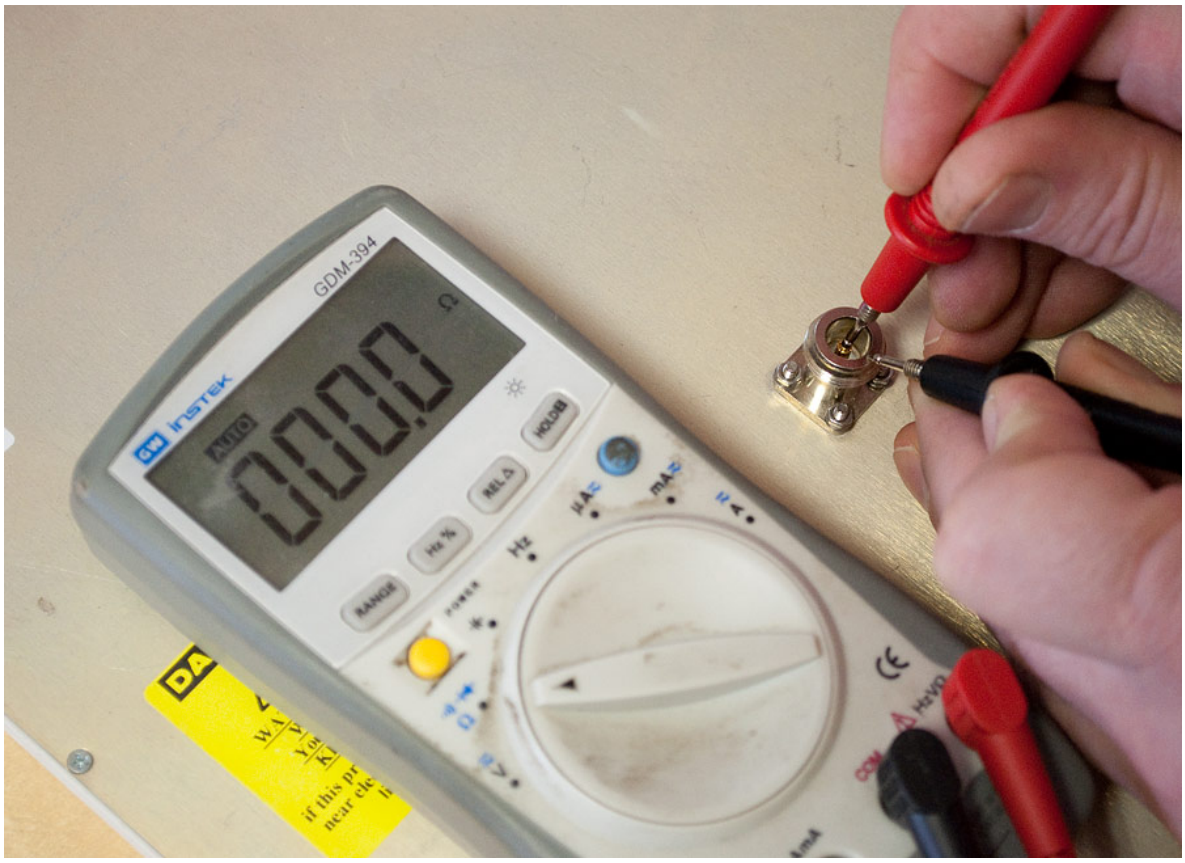
Close-up of testing area:



DC shorted antennas

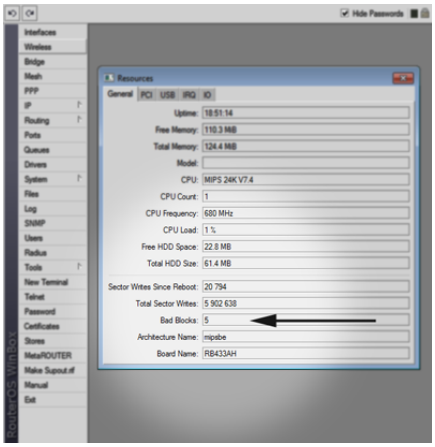
Also make sure that your antenna is DC shorted:

DC shorted antenna. This antenna doesn't need a Coax lightning arrestor:



NOT DC shorted antenna. This antenna needs a Coax lightning arrestor to avoid sudden wireless card damage. Note the OL (Open Loop) in the multimeter:

Manual:RouterBOARD bad blocks



Every once in a while, one can notice a number of **bad blocks** appearing in the RouterBOARD resource page. A bad block indicates a problem to write in one part of the NAND storage device, but it doesn't affect the performance of your router, and it doesn't give any indication of quality. According to the manufacturer of NAND chips, up to 5 blocks can be bad when NAND is manufactured, and up to 80 bad blocks could develop during operation, but it will **not** disturb the operation of your router, because complex workaround mechanisms are in place, that will copy the data to another block and attempt to fix the bad block.

- **Note**! *If more than a 100 bad blocks (more than 5% in new versions) should develop in the NAND chip of a RouterBOARD device, you should try to reinstall RouterOS with Netinstall, and it will reduce the number of bad blocks*

Since RouterOS v5.18, NAND is refreshed every few minutes which increases sector writes by ~32 per refresh. This is to ensure evenly distributed NAND wear, to increase protection against data loss as compared to previous versions. As the manufacturer of the NAND chip guarantees 100'000 write cycles to the NAND sectors, 32 sector writes per refresh would mean NAND life is about 100'000 weeks.

If you are planning to use the RouterBOARD as an active caching or logging server, an external drive or a replaceable memory card could be a better alternative than keeping them on the NAND chip. Note that several RouterBOARD models support USB external drives and different types of memory cards.

Important! As you can see in the screenshot above, RouterOS shows you writes per NAND TOTAL, not writes per sector. This is different than the given 100'000 write guarantee per sector.

Manual:Password reset

RouterOS password can only be reset by reinstalling the router, or using the reset button (or jumper hole) in case the hardware is RouterBOARD.

For X86 devices, only complete reinstall will clear the password, along with other configuration. For RouterBOARD devices, several methods exist, depending on our model.

Button reset

Most RouterBOARD devices are fitted with a reset button.

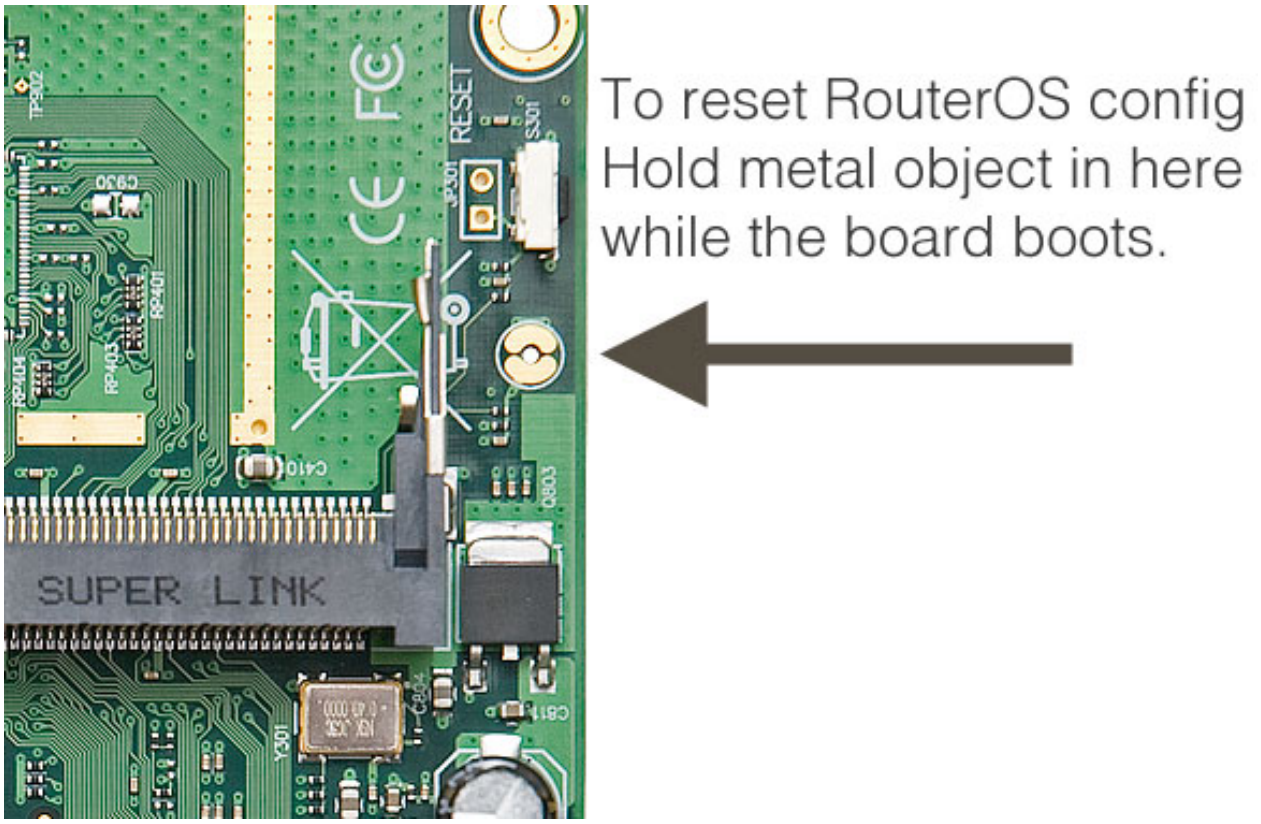
Using: unplug the device power, hold the button, apply power and wait until the USER LED starts flashing. Now release the button to clear configuration.

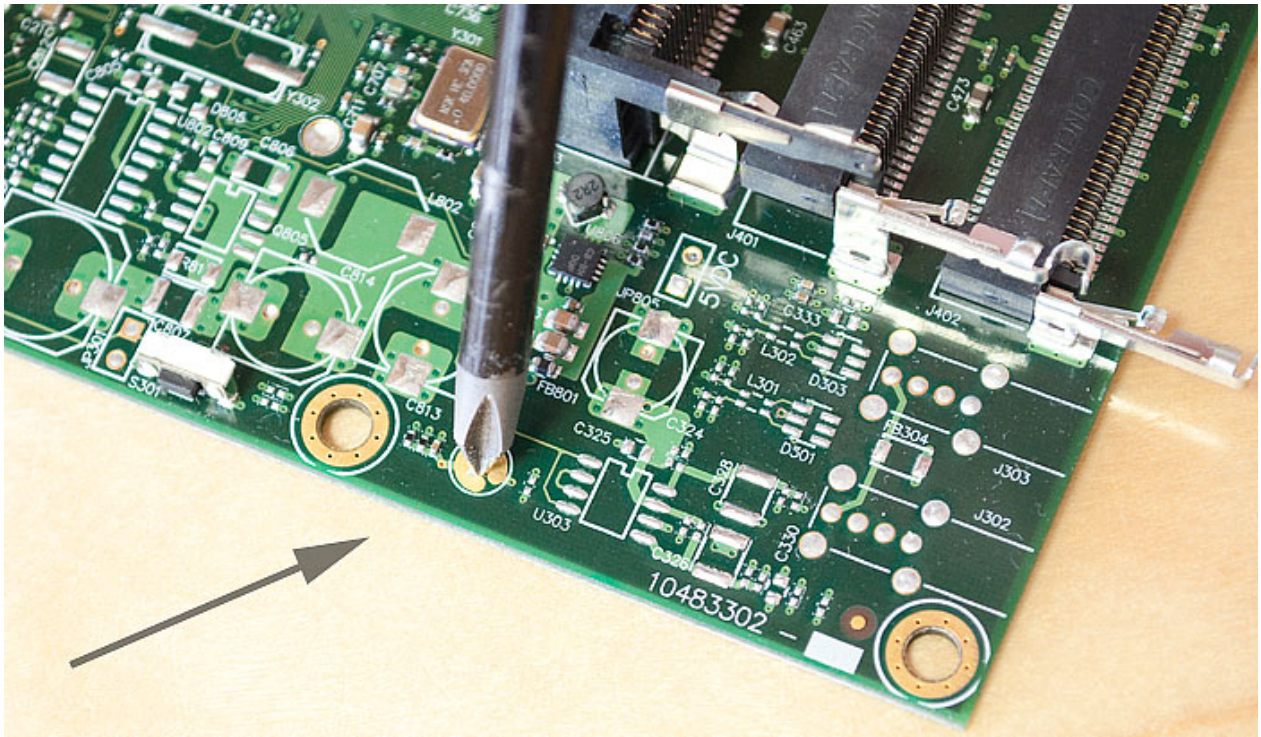
Note: If you wait until LED stops flashing, and only then release the button - this will instead launch Netinstall mode, to reinstall RouterOS.

Jumper hole reset

All RouterBOARD current models are also fitted with a reset jumper hole. Some devices might need opening of the enclosure, RB750/RB951/RB751 have the jumper hole under one of the rubber feet of the enclosure.

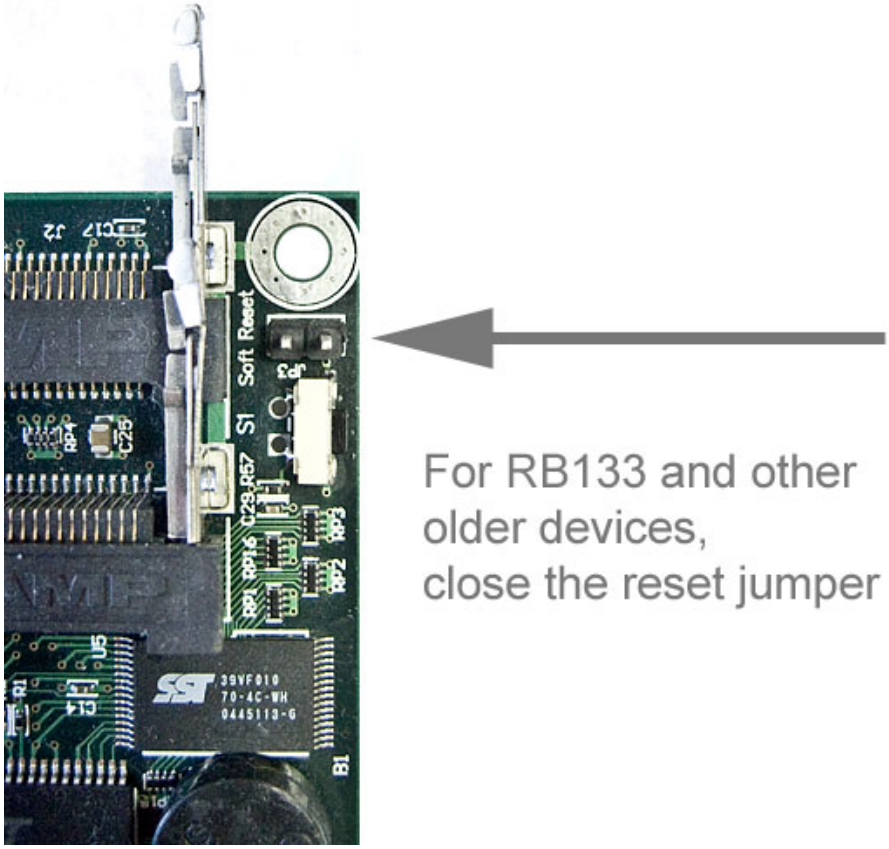
Using: Close the jumper with a metal screwdriver, and boot the board until the configuration is cleared.





Jumper reset for older models

The **below** image shows the location of the Reset Jumper on older RouterBOARDs like RB133C:



Note: Don't forget to remove the jumper after configuration has been reset, or it will be reset every time you reboot.

Manual:Flashfig

Applies to RouterOS: v4

Description

Flashfig is an application for mass router configuration. It can be used by MikroTik distributors, ISPs or any other companies who need to apply RouterOS configuration to many routers in shortest possible time.

Flashfig applies MikroTik RouterOS **configuration** to any RouterBOARD within **3 seconds**. You can "flashfig" batch of routers, the only thing you need - **connect** RouterBOARD to network and **power** it.

Flashfig runs on a Windows computer, Flashfig is available within Netinstall [1].

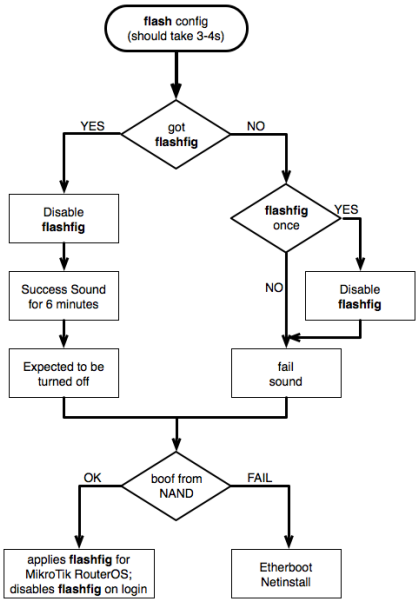
Flashfig is supported by all RouterBOARDs [2]. It works between computer with Flashfig and RouterBOARD in the same broadcast domain (direct Ethernet network connection is required).

Flashfig support is enabled on every new RouterBOARD by default from factory (RouterBOARDs manufactured after March 2010). For older models, Flashfig can be enabled via RouterBOOT or from MikroTik RouterOS console.

After Flashfig is used once on a brand new RouterBOARD, it is disabled to avoid unwanted reconfiguation at later time. To use Flashfig a second time on the same router, you need to enable it in Bootloader settings.

If RouterOS *reset-configuration* command is used later, Flashfig configuration is not loaded, but RouterOS default configuration.

Flashfig diagram shows the procedure of Flashfig,

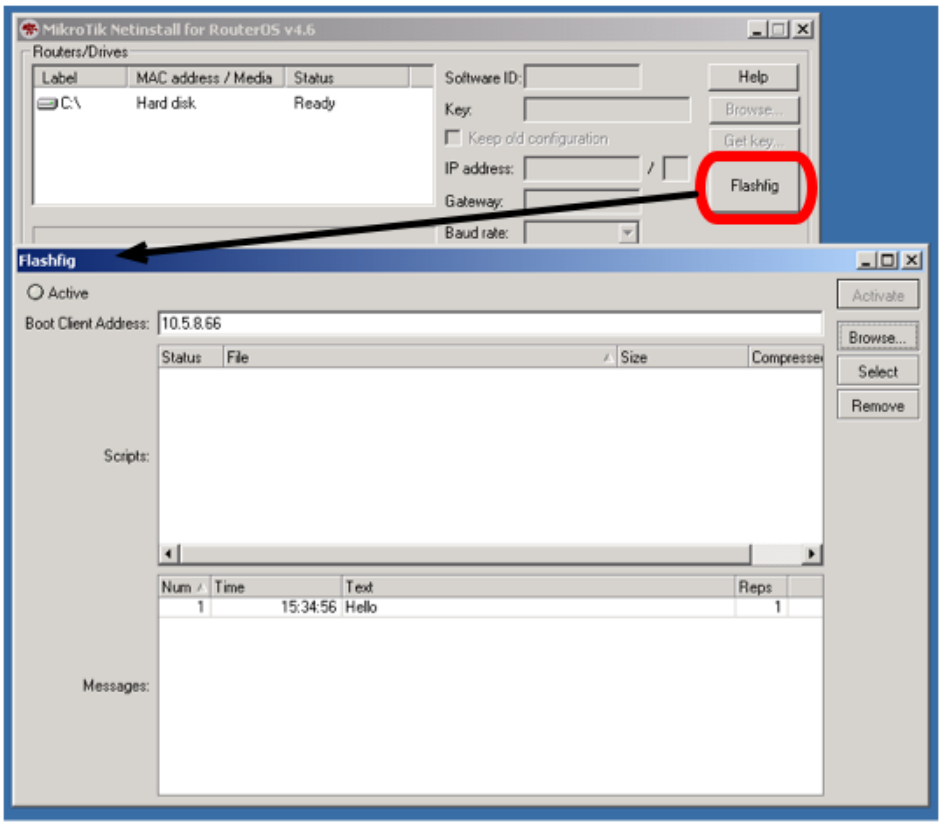


Flashfig Example

This is a step by step example of how to use Flashfig to set typical MikroTik RouterOS configuration to RouterBOARD.

Introduction

Flashfig is available from Netinstall,



Requirements

The Windows computer must be equipped with the following ports and contain the following files:

- Ethernet port;
- The .rsc file(s) with MikroTik RouterOS configuration (the same as export/import file);
- The latest NetInstall/Flashfig program available from the downloads [3] page;

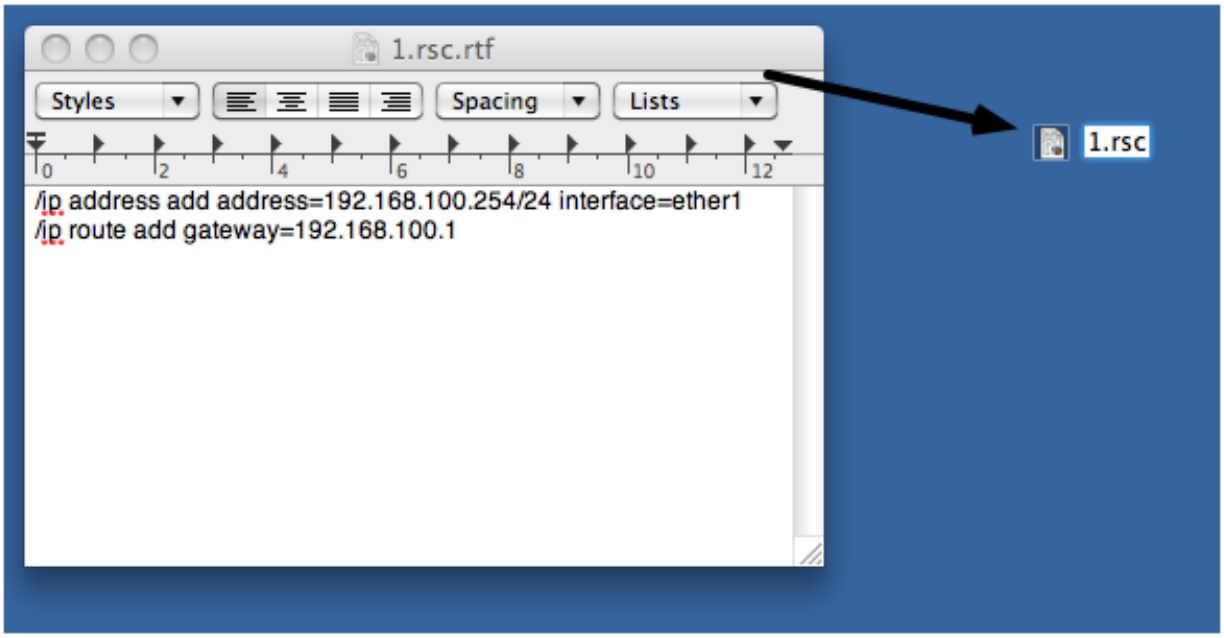
The RouterBOARD:

- Flashfig is supported by first boot of RouterBOARD;

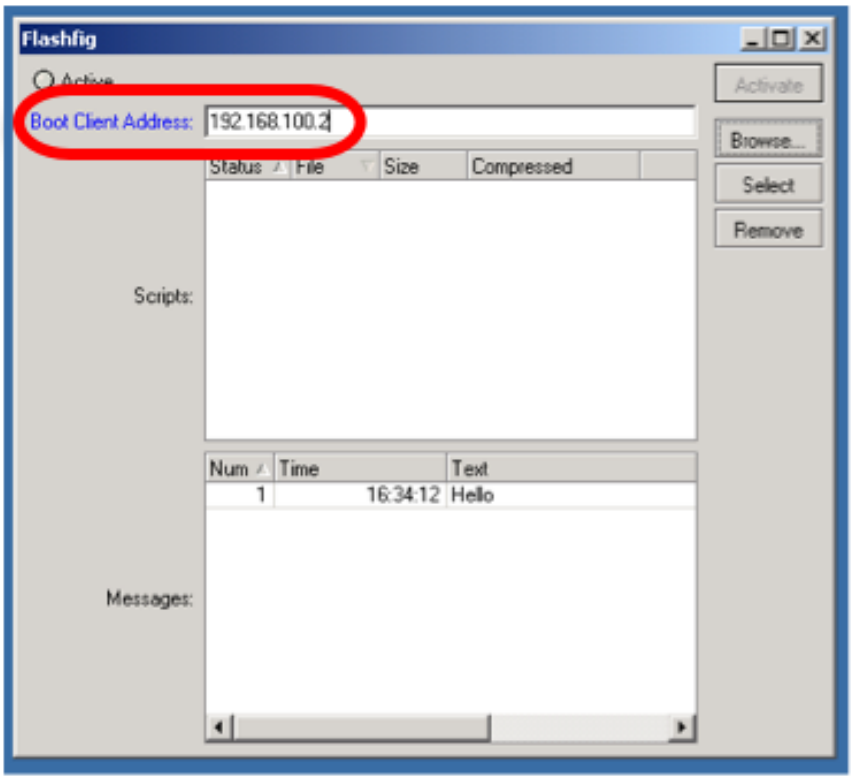
Pre-Configuration

Windows Computer

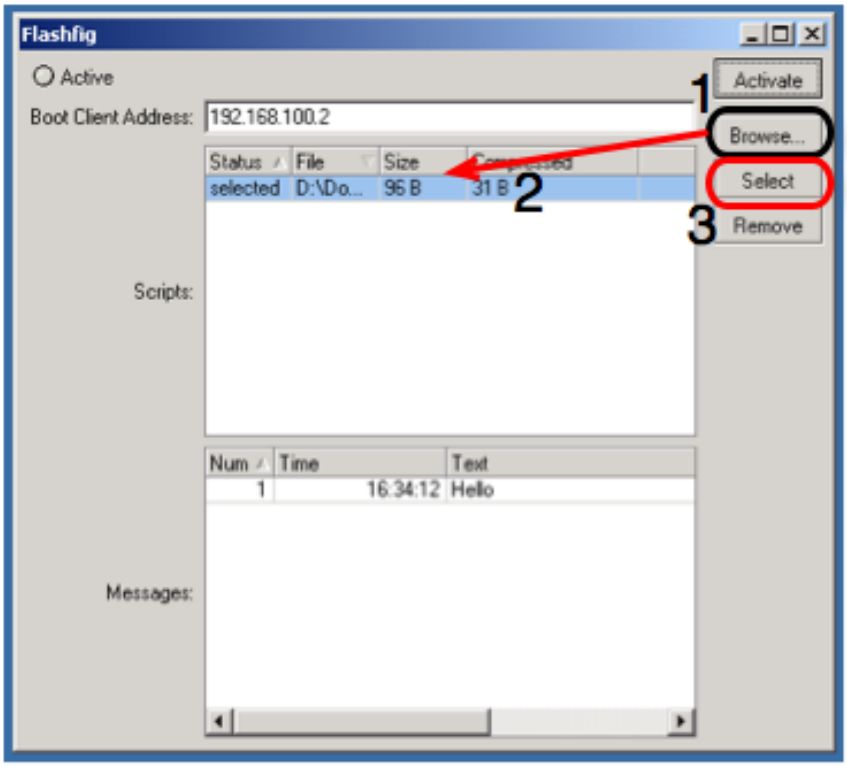
- Run Flashfig;
- Prepare **.rsc** file, **.rsc** file is regular/import file, it accepts valid MikroTik RouterOS CLI commands. You can create .rsc file by any text-editor program (Notepad, Texteditor, TextEdit, Microsoft Word, OpenOffice Writer);



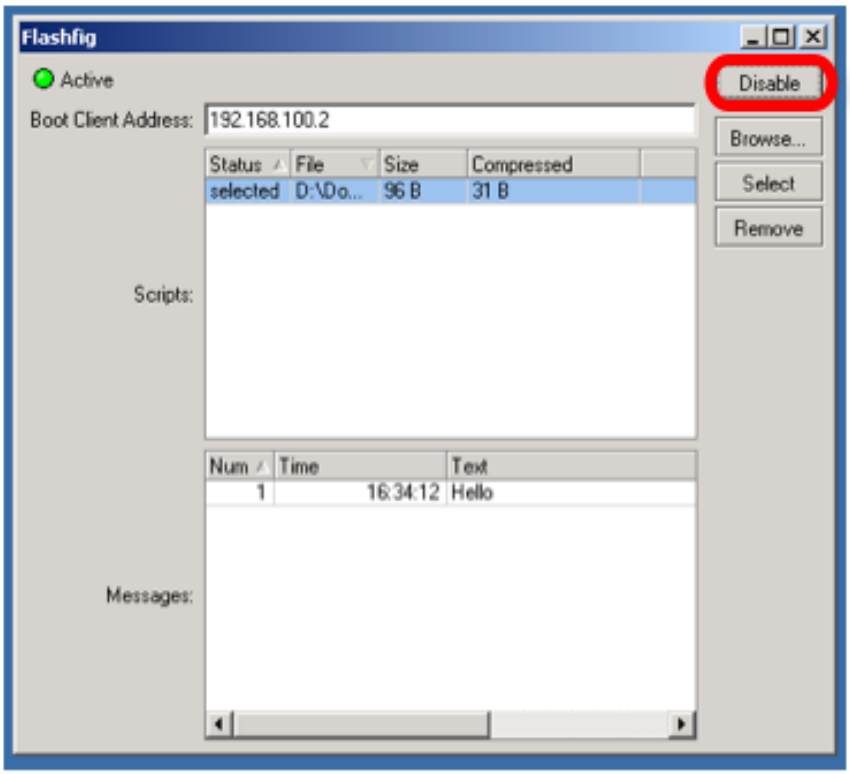
- Assign **Boot Client Address**, which should be address from the same subnet as configured on laptop Ethernet interface,



- **Browse** for **.rsc** MikroTik RouterOS configuration file to apply to RouterBOARD, highlight the file and **Select** to approve it,



- Activate Flashfig server, now it is ready to Flashfig. Note, any RouterBOARD will be flashfiged within the network, which is powered on with boot-device configured to **flash-boot** or **flash-boot-once-then-nand**,



RouterBOARD

- Flashfig mode is enabled on every RouterBOARD from factory by default, which means **no configuration** is required on RouterBOARD.
- If Flashfig is not enabled on your router, access the RouterBOARD with Winbox/Console and set the configuration,

```
/system routerboard settings set boot-device=flash-boot
```

or use more preferable option,

```
/system routerboard settigs set boot-device=flash-boot-once-then-nand
```

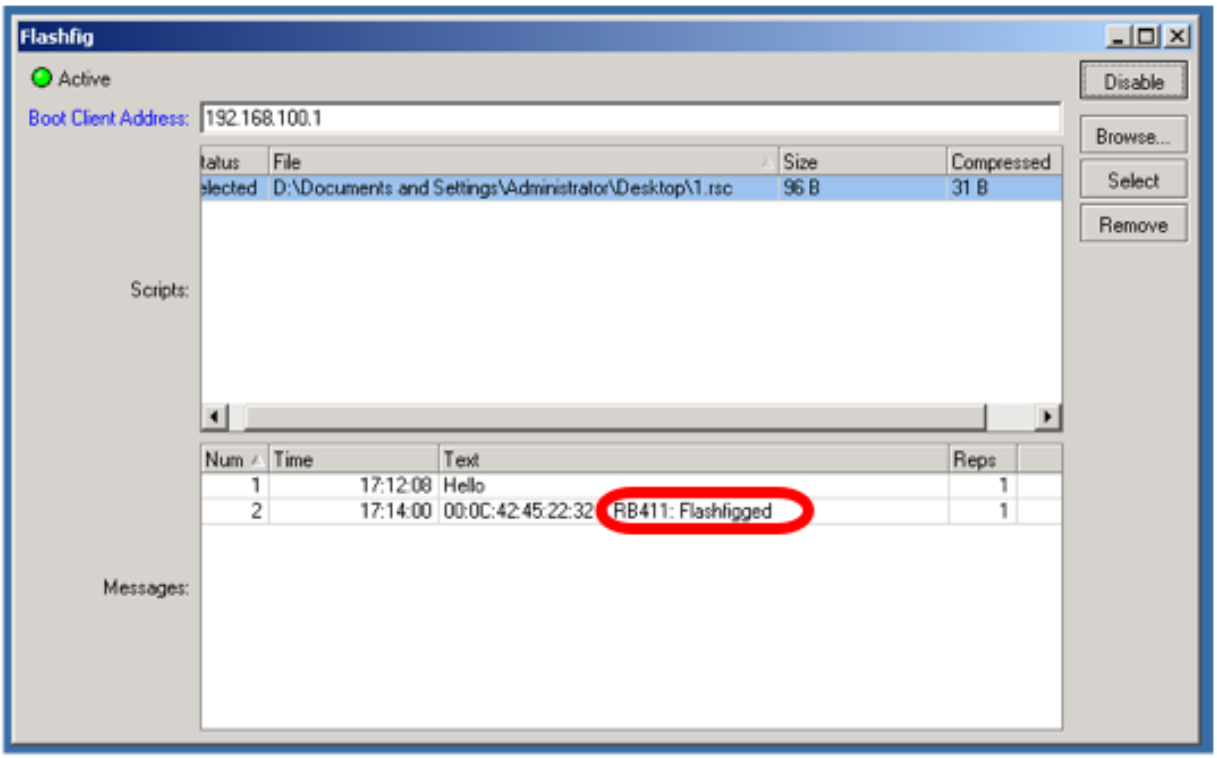
Your router is now ready for Flashfig.

Connect

Connect RouterBOARD and Flashfig computer to the same Local Area Network.

Run Flashfig

- Plug power for RouterBOARD
- Check the status on Flashfig program,



Log shows "RouterBOARD Flashfigged" and RouterBOARD should make sound/LED signal, now it is safe to unplug the router.

- Flashig **configuration** was applied to the RouterBOARD and it is **ready** to be used in production.

References

[1] http://www.mikrotik.com/download/netinstall-4.5b.zip
[2] http://www.routerboard.com
[3] http://www.mikrotik.com/download.html

Manual:Bootloader upgrade

This page shows how to upgrade the Bootloader firmware of a RouterBOARD device.

Simple Upgrade

- Run command */system routerboard upgrade*
- Reboot your router to apply the upgrade (*/system reboot*)]

Note! If you need to install a different version than included in your "routerboard.npk - Upload the latest RouterBOOT firmware to your router's FTP, the latest firmware is available on routerboard.com [2] and then follow above steps.

Checking RouterBOOT version

This command shows the current RouterBOOT version of your device, and available upgrade which is *either included in routerboard.npk package, or if you uploaded a FWF file* corresponding to device model:

```
[admin@MikroTik] > system routerboard print
       routerboard: yes
             model: "750"
     serial-number: "1FC201DD513B"
  current-firmware: "2.18"
  upgrade-firmware: "2.20"
[admin@MikroTik] >
```

In this case you see, that there is **a newer version** of the Bootloader firmware available already inside your current RouterOS version.

Xmodem Method

If there is no IP connectivity with your RouterBOARD, you can also use the Serial Console XMODEM transfer to send the FWF file to the router, while connected via Serial Console. From the Bootloader menu it's possible to upgrade the firmware with this method. This method is the last resort, and should be used only if the first two methods are not available.

Manual:System/Certificates

Applies to RouterOS: v6.0 +

Summary

Sub-menu: `/certificate`
Package required: `security`
Standards: `RFC 5280, draft-nourse-scep-22`

Certificate manager is used to collect all certificates inside router, to manage and create serlf-signed certificates and to control and set SCEP related configuration.

Note: Starting from v6 certificate validity is shown using local time zone offset. In previous versions it was UTF.

Warning: RSA Key length must be at least 472 bits if certificate is used by SSTP. Shorter keys are considered as security threats.

Starting from v6rc10, CRL will be automatically renewed every hour for certificates which have "trusted=yes" using http protocol (ldap and ftp is currently unsupported). Segmented CRL is also currently unsupported.

RouterOS allows to manage and create self-signed CAs. Implementation was made based on RFC 5280 and all certificates are X.509 v3.

All certificate fingerprints are SHA1. All private keys and CA export passphrase are stored encrypted with hardware ID. CA CRL renewal happens at every certificate revocation and after 24hours.

Note: Time and date on routers MUST be correct

General Menu

Sub-menu: `/certificate`

General menu is used to manage certificates, add templates, issue certificates and manage SCEP Clients.

Note: Certificate templates are deleted right after certificate issue or certificate request command is executed

Note: If CA certificate is removed then all issued certificates in chain are also removed

Properties

Property	Description
common-name (*string*; Default:)	
country (*string*; Default:)	
days-valid (*integer [0..4294967295]*; Default:)	
email (*string*; Default:)	
key-size (*1024* | *1536* | *2048* | *4096* | *8192*; Default:)	
key-usage (*list of [digital-signature* | *content-commitment* | *key-encipherment* | *data-encipherment* | *key-agreement* | *key-cert-sign* | *crl-sign* | *encipher-only* | *decipher-only]*; Default:)	
locality (*string*; Default:)	
name (*string*; Default:)	Name of the certificate. Name can be edited.
organization (*string*; Default:)	
state (*string*; Default:)	
trusted (*yes* | *no*; Default:)	If set to **yes** certificate is included "in trusted certificate chain"
unit (*string*; Default:)	

Read-only Properties

Property	Description
authority ()	
ca ()	
ca-crl-host ()	
ca-fingerprint ()	
crl ()	
dsa (*yes* | *no*)	
expired (*yes* | *no*)	Set to true if certificate is expired
fingerprint ()	
invalid-after (*date*)	The date after which certificate wil be invalid.
invalid-before (*date*)	The date before which certificate is invalid.
issued ()	
issuer (*string*)	
private-key (*yes* | *no*)	
req-fingerprint ()	
revoked ()	
scep-url (*string*)	

serial-number (*string*)

smart-card-key (*string*)

status ()

Commands

Command	Description
add ()	Adds new certificate template.
add-scep (*name on-smart-card scep-url template*)	Add scep client. Command takes four parameters: • **name** - display name of scep client • **on-smart-card** - whether to use smart card • **scep-url** - • **template** - which template to use from template list
ca-set-passphrase ()	
card-reinstall ()	
card-verify ()	
create-certificate-request ()	Create certificate request from specified template.
export ()	Export certificate to file. When `export-passphrase` is specified, certificate will be exported with encrypted key.
import (*file-name*)	File name of certificate or key to be imported.
issued-revoke ()	Revoke issued certificate
scep-renew ()	
sign-ca ()	Sign CA certificate from created template. When signing CA you can specify `ca-crl-host` if crl should be used.
sign-certificate-request (*ca, days-valid, file-name, key-bits*)	Generates certificate and key, except that standard parameters are taken from certificate request. Command takes four parameters: • **ca** - name of the CA certificate • **days-valid** - validity period • **file-name** - certificate request filename • **key-bits** - RSA key bits
sign-issued ()	Sign issued certificate (client, server..etc) from CA and template

SCEP

Sub-menu: `/certificate`
Standards: `draft-nourse-scep-22`

Simple Certificate Enrollment protocol (SCEP) was developed based on draft-nourse-scep-22.

The protocol is designed so that any user can request certificate as simple as possible. The protocol allows to issue and revoke certificates.

How SCEP works

Topology: CL ---- RA ---- CA

- CL - client
- RA - registration authority (proxy)
- CA - certification authority (server)

SCEP is using HTTP protocol and base64 encoded **GET** requests. Most of requests are without authentication and cipher, however important ones can be protected if necessary (ciphered or signed using received public key).

SCEP client in RouterOS will:

- get CA certificate from CA server or RA (if used);
- user should compare fingerprint of the CA certificate or if it comes from the right server;
- generate self-signed certificate with temporary key;
- sends certificate request to the server;
- if server respond with status **x**, then client keeps requesting until server sends an error or approval.

SCEP server supports issue of one certificate only. RouterOS supports also renew and next-ca options:

- **renew** - possibility to renew old certificate automatically with the same CA.
- **next-ca** - possibility to change current CA certificate to the new one. Client polls the server for any changes, if server advertise that next-ca is available, then client may request next CA or wait until CA almost expires and then request next-ca.

RouterOS Server also supports *POST*' operation, **3DES** cipher and **SHA1** hashing. If client does not support these features then http **GET**, **DES** cipher and **MD5** hashing is used.

RouterOS client by default will try to use POST, 3DES and SHA1 if server advertises that.

Client

Sub-menu: `/certificate scep client`

Properties

Property	Description
ca-identity (*string*; Default: **DummyCAIdentity**)	
challenge-password (*string*; Default: **""**)	OTP password on the server used to grant certificate automatically after request.
common-name (*string*; Default:)	
country (*string*; Default:)	
disabled (*yes* | *no*; Default: **no**)	
email (*string*; Default:)	
fingerprint-algorithm (*md5* | *sha1*; Default: **sha1**)	
key-bits (*1024* | *2048* | *4096*; Default: **1024**)	
locality (*string*; Default:)	
name (*string*; Default:)	Short descriptive name of an item
organziation (*string*; Default:)	
path (*string*; Default:)	Path of certificate located on the server. If server is RouterOS then you should add "scep/"+path since certificates on server are stored in "scep" dir.
serial-number (*string*; Default:)	
server (*IP* | *IPv6*; Default:)	IP or IPv6 address of the SCEP server
state (*string*; Default:)	
store-name (*string*; Default:)	Name of the certificate which will be used after importing into certificate store.
unit (*string*; Default:)	

Status Properties

Property	Description
ca-fingerprint (*string*)	
req-fingerprint (*string*)	
status (*string*)	Shows the current status of the client. Idle, pending, requesting etc.

Commands

Command	Description
renew (*ca_client_name*)	Renew Ca certificate of specified CA client Name.

Server

Sub-menu: `/certificate scep server`

OTP

Sub-menu: `/certificate scep server otp`

Transactions

Sub-menu: `/certificate scep server transactions`

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Manual:Create Certificates

Following is a step-by-step guide to creating your own CA (Certificate Authority) with openssl on Linux.

Generate certificates

Note: Starting from v5.15 RouterOS supports **pkcs8** key format. If you are using older versions, to import keys in pkcs8 format run command:
`openssl rsa -in myKey.key -text` and write key output to new file. Upload new file to RouterOS and import

- First step is to build the CA private key and CA certificate pair.

```
openssl genrsa -des3 -out ca.key 4096
openssl req -new -x509 -days 3650 -key ca.key -out ca.crt
```

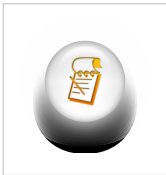
During the process you will have to fill few entries (Common Name (CN), Organization, State or province .. etc). Created CA certificate/key pair will be valid for 10 years (3650 days).

- Now create private-key/certificate pair for the server

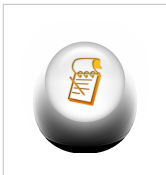
```
openssl genrsa -des3 -out server.key 4096
openssl req -new -key server.key -out server.csr

openssl x509 -req -days 3650 -in server.csr -CA ca.crt -CAkey ca.key -set_serial 01 -out server.crt
```

Warning: RSA Key length must be at least 472 bits if certificate is used by SSTP. Shorter keys are considered as security threats.

And again during the process you will have to fill some entries. When filling CN remember that it must not match on CA and server certificate otherwise later naming collision will occur.



Note: Common Name (CN) in server certificate should match the the IP address of your server otherwise you will get **"domain mismatch"** message and for example Windows SSTP client will not be able to connect to the server. If clients are only Windows machines then CN can be a DNS name, too.



Note: If you are using "My ID user FQDN" in IpSec config then "subjectaltname" extension should be set on certificate, and must match the value set on remote peers "My ID user FQDN".

- Client key/certificate pair creation steps are very similar to server. Remember to Specify unique CN.

```
openssl genrsa -des3 -out client.key 4096
openssl req -new -key client.key -out client.csr

openssl x509 -req -days 3650 -in client.csr -CA ca.crt -CAkey ca.key -set_serial 01 -out client.crt
```

To examine certificate run following command:

```
openssl x509 -noout -text -in server.crt -purpose
```

Import certificates

To import newly created certificates to your router, first you have to upload server.crt and server.key files to the router via FTP. Now go to `/certificate` submenu and run following commands:

```
[admin@test_host] /certificate> import file-name=server.crt
passphrase:
     certificates-imported: 1
     private-keys-imported: 0
            files-imported: 1
       decryption-failures: 0
  keys-with-no-certificate: 0
[admin@test_host] /certificate> import file-name=server.key
passphrase:
     certificates-imported: 0
     private-keys-imported: 1
            files-imported: 1
       decryption-failures: 0
  keys-with-no-certificate: 0
```

If everything is imported properly then certificate should show up with **KR** flag.

```
[admin@test_host] /certificate> print
Flags: K - decrypted-private-key, Q - private-key, R - rsa, D - dsa
```

```
0 KR name="cert1" subject=C=LV,ST=RI,L=Riga,O=MT,CN=server,emailAddress=xxx@mt.lv
     issuer=C=LV,ST=RI,L=Riga,O=MT,CN=MT CA,emailAddress=xxx@mt.lv serial-number="01"
     email=xxx@mt.lv invalid-before=jun/25/2008 07:24:33
     invalid-after=jun/23/2018 07:24:33 ca=yes
```

Note: If you want to use server certificates for OVPN or SSTP and use client certificate verification, then CA certificate must be imported, too.

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Manual:Tools/Traffic Generator

Applies to RouterOS: v5 +

Summary

Traffic Generator is a tool that allows to evaluate performance of DUT (Device Under Test) or SUT (System Under Test).

Tool can generate and send RAW packets over specific ports. It also collects latency and jitter values, tx/rx rates, counts lost packets and detects Out-of-Order (OOO) packets.

Traffic Generator can be used similar to bandwidth test tool as well as generate packets that will be routed back to packet generator for advanced status collection.

General

Sub-menu `/tool traffic-generator`

This menu allows to set general traffic generator properties and contains commands to quickly start and stop the tool.

Properties

Property	Description
latency-distribution-scale (*integer [0..28]*; Default: **10**)	
test-id (*integer [0..255]*; Default: **0**)	

Read-Only Properties

Property	Description
latency-distribution-samples (*integer*)	
latency-distribution-measure-interval (*time*)	
running (*yes* | *no*)	Shows whether traffic generator tool is started.

Commands

Property	Description
quick ()	This command allows to quickly start packet generator and print the stats output to the terminal. Command also accept several parameters that overrides settings in packet template and stream settings. Accepted parameters are **duration, entries-to-show, freeze-frame-interval, mbps, num, packet-size, port, pps, stream, test-id, tx-template** • `duration` - how long to run the test • `entries-to-show` - how many status lines print to the terminal • `freeze-frame-interval` - how often to update status to the terminal The rest of the parameters are not command specific and are described elsewhere. Parameters specified when running quick command overrides configured values. In case if parameter is specified only for one header then value is multiplied for all the other headers (if required).
start ()	Commands starts the traffic generator tool in the background. It accepts one parameter **test-id**
stop ()	Command stops the started traffic generator tool by **start** command.

Packet Template

Sub-menu `/tool traffic-generator packet-template`

This sub menu allows to build packet based on provided parameters. Based on parameters you can build ip packet with vlan tags and set udp ports. Raw packet template is generated based on provided parameters.

If you require more low level packet or take full advantage of traffic generator, then please use raw-packet-template builder to build the packet.

If same type of header is present in packet more than once then header field values are passed as comma separated list. (For example if there are two ip headers then source addresses are given like "ip-src=1.1.1.1,2.2.2.2").

For quicker header construction many of the header field values are assumed. For example if header stack is "mac,ip" then traffic generator can assume that mac-protocol value is "ip". Or if "port" or "interface" setting is specified traffic generator can assume "mac-src" to be MAC address of interface). Assumed values have distinct names that start with "assumed-" and are read only. Manually specified values override assumed ones.

Note: Assumed values are not automatically updated. New values are assumed after template edit. "packet-template set 0" is enough to trigger new assumed values

Properties

Property	Description
comment (*string*; Default:)	Short description of packet you are building.
data (*incrementing* | *random* | *specific-byte* | *uninitialized*; Default: **uninitialized**)	Specifies how packet payload will be filled: • **uninitialized** - packets data (after header) is uninitialized, but not zero. Fastest. • **specific-byte** - works together with setting data-byte • **incrementing** - packets data filled with "00 01 02 03" and so on • **random** - packets data filled with random bytes. Slowest.
data-byte (*hex [0..FF]]*; Default: **0**)	Byte that will be used to fill packet payload.
interface (*string*; Default:)	Optional parameter of packet template. This is mutually exclusive with "port" setting. Specifying "interface" allows user not to create a port entry for interface in port menu. In fact a port entry is created dynamically. This is useful for running quick tests.
ip-dscp (*list of integer[0..255] (max 16 times)*; Default:)	Single DSCP or list of DSCP values that will be set in IP header
ip-dst (*list of IP/Netmask (max 16 times)*; Default:)	List of destination IP addresses that will be used when generating IP headers.
ip-frag-off (*list of integer[0..65535] (max 16 times)*; Default:)	List of fragmentation offsets in IP header.
ip-gateway (*IP*; Default:)	In situations when sender and receiver is the same device, it is impossible to determine nexthop automatically from **ip-dst**. If ip-gateway is specified packet template will assume destination mac address based on resolved ip-gateway.
ip-id (*list of integer [0..65535]*; Default:)	
ip-protocol (*list of IP protocols (max 16 times)*; Default:)	
ip-src (*list of IP/Mask (max 16 times)*; Default:)	
ip-ttl (*list of integer [0..255] (max 16 times)*; Default:)	
mac-dst (*list of MAC/MASK (max 16 times)*; Default:)	
mac-protocol (*list of mac protocols (max 16 times)*; Default:)	
mac-src (*list of MAC/MASK (max 16 times)*; Default:)	
name (*string*; Default:)	Descriptive name of the template.
port (*string*; Default:)	Optional parameter of packet template. This suggests a port through which packets generated using this template should be sent out. Port can also be specified in other places such as in stream settings. This is mutually exclusive with interface setting.
raw-header (*string (max 16 times)*; Default:)	Raw packet header as string in hexadecimal format.
udp-dst-port (*list of port [0..65535]/mask [0..FFFF] (max 16 times)*; Default:)	
udp-src-port (*list of port [0..65535]/mask [0..FFFF] (max 16 times)*; Default:)	

vlan-id (; Default:)

vlan-priority (; Default:)

vlan-protocol (; Default:)

header-stack (*list of ip | mac | raw | udp | vlan (max 16 times)*; Default: **ip**)

Sequence of headers that a generated packet should have.

Currently supports:

- **mac** - Ethernet header (14 bytes)
- **vlan** - Ethernet VLAN tag (4 bytes)
- **ip** - IPv4 header (20 bytes)
- **udp** - UDP header (8 bytes)
- **raw** - arbitrary bytes specified as hex string

Most header types can be present in header multiple times. There can be only 2 ip headers and 1 udp header per packet. Some limitations are imposed on possible sequences of headers based on our practical experience with network protocols (for example vlan header can follow only a mac header or other vlan header).

Traffic generator suggests first header for a packet template (in port menu). But it is not enforced.

Port Configuration

Sub-menu `/tool packet-generator port`

This menu allows to configure ports that will be associated to specific interface and will be used to receive/send generated packets.

Properties

Property	Description
disabled (*yes* | *no*; Default: **no**)	Whether port is disabled and does not participate in receiving/sending of the packets
name (*string*; Default:)	Descriptive name of the port
interface (*string*; Default:)	Name of the interface associated with the port.

Read-Only Properties

Property	Description
dynamic (*yes* | *no*)	Whether port configuration is generated automatically.
first-header (*ip* | *mac* | *raw* | *udp* | *vlan*)	Shows suggested first header for packets to be sent out of specified interface. This is information can be used when creating packet templates.
inactive (*yes* | *no*)	Whether port is inactive and can't participate in tx/rx of the packets.

Stats

Sub-menu `/tool traffic-generator stats`

If traffic generator is not running in **quick** mode then all statistics about the test is stored in this menu.

Latency Distribution

Sub-menu `/tool traffic-generator stats latency-distribution`

This sub-menu shows how many packets are received in specific latency range. Latency range can be viewed by streams or by sequences (for example, **print stream-num=3**, **print seq=10**)

Here is an example output of the latency graph:

```
[admin@test-host] /tool traffic-generator stats latency-distribution> print
 # LATENCY                  COUNT        SHARE GRAPH
 0 0-15.5us                     0           0%
 1 15.5us-31us                  0           0%
 2 31us-46.5us                  0           0%
 3 46.5us-62.1us                0           0%
 4 62.1us-77.6us                0           0%
 5 77.6us-93.1us                0           0%
 6 93.1us-109us                 0           0%
 7 109us-124us                  0           0%
 8 124us-140us                  0           0%
 9 140us-155us                  0           0%
10 155us-171us                  0           0%
11 171us-186us                  4           0% *
12 186us-202us                 29           0% *
13 202us-217us                 90       0.001% *
14 217us-233us                302       0.004% *
15 233us-248us                630       0.009% *
16 248us-264us                789       0.011% *
17 264us-279us              1 384       0.021% -*
18 279us-295us              1 990        0.03% --*
19 295us-310us              2 966       0.045% ---*
20 310us-326us              4 089       0.062% -----*
21 326us-341us              4 958       0.075% ------*
22 341us-357us              6 059       0.091% -------*
23 357us-372us              6 660       0.101% --------*
24 372us-388us              8 320       0.126% ----------*
25 388us-403us              9 988       0.151% -------------*
26 403us-419us             11 781       0.178% ---------------*
27 419us-434us             12 512       0.189% ----------------*
28 434us-450us             13 836        0.21% -----------------*
29 450us-465us             15 681       0.238% ---------------------*
30 465us-481us             17 740       0.269% ------------------------*
31 481us-496us             19 913       0.302% --------------------------*
32 496us-512us             21 106        0.32% ----------------------------*
33 512us-528us             22 848       0.346% ------------------------------*
34 528us-543us             25 059        0.38% --------------------------------*
35 543us-559us             26 593       0.403% ----------------------------------*
36 559us-574us             27 663       0.419% ------------------------------------*
37 574us-590us             29 351       0.445% --------------------------------------*
38 590us-605us             31 265       0.474% ----------------------------------------*
39 605us-621us             33 224       0.504% ------------------------------------------*
40 621us-636us             34 464       0.523% --------------------------------------------*
41 636us-652us             35 630        0.54% ----------------------------------------------*
42 652us-667us             37 245       0.565% ------------------------------------------------*
43 667us-683us             38 158       0.579% --------------------------------------------------*
44 683us-698us             38 626       0.586% ---------------------------------------------------*
```

```
45 698us-714us            38 985       0.591% ------------------------------------------------*
46 714us-729us            39 061       0.592% ------------------------------------------------*
47 729us-745us            39 750       0.603% -------------------------------------------------*
48 745us-760us            39 145       0.594% ------------------------------------------------*
49 760us-776us            39 162       0.594% ------------------------------------------------*
50 776us-791us            38 197       0.579% -----------------------------------------------*
51 791us-807us            37 811       0.573% -----------------------------------------------*
52 807us-822us            37 364       0.567% ----------------------------------------------*
53 822us-838us            36 770       0.558% ----------------------------------------------*
54 838us-853us            35 831       0.543% ---------------------------------------------*
55 853us-869us            35 380       0.536% ---------------------------------------------*
56 869us-884us            34 472       0.523% --------------------------------------------*
57 884us-900us            33 672       0.511% -------------------------------------------*
58 900us-915us            33 799       0.513% -------------------------------------------*
59 915us-931us            32 754       0.497% ------------------------------------------*
60 931us-946us            32 339        0.49% ------------------------------------------*
61 946us-962us            32 419       0.492% ------------------------------------------*
62 962us-977us            32 107       0.487% -----------------------------------------*
63 977us-993us            31 552       0.478% -----------------------------------------*
64 0-993us             1 221 523       18.54%
```

Properties

Property	Description
count (*integer*)	Number of packets in current latency range
graph (*string*)	graphical representation of share
latency (*string*)	latency range
share (*precent*)	Percentage of packets falling in this latency range.

Stream Stats

Sub-menu `/tool traffic-generator stats stream`

This sub-menu stores statistics sorted by streams. Output is the same as in **quick** mode.

```
[admin@test-host] /tool traffic-generator stats stream> print
 # SEQ    NUM     TX-PACKET   TX-RATE     RX-PACKET   RX-RATE   LOST-PACKET LOST-RATE
 0 1      3          43 064 499.5Mbps        25 180 292.0Mbps        17 884 207.4Mbps
 1 1      4          43 062 499.5Mbps        39 946 463.3Mbps         3 116  36.1Mbps
 2 1      TOT        86 126 999.0Mbps        65 126 755.4Mbps        21 000 243.6Mbps
 3 2      3          43 544 505.1Mbps        30 449 353.2Mbps        13 095 151.9Mbps
 4 2      4          43 543 505.0Mbps        42 982 498.5Mbps           561   6.5Mbps
 5 2      TOT        87 087 1010.2...        73 431 851.7Mbps        13 656 158.4Mbps

...

59 20     TOT        87 277 1012.4...        73 755 855.5Mbps        13 522 156.8Mbps
60 21     3          43 546 505.1Mbps        30 605 355.0Mbps        12 941 150.1Mbps
61 21     4          43 546 505.1Mbps        42 682 495.1Mbps           864  10.0Mbps
```

```
62 21     TOT         87 092 1010.2...         73 287 850.1Mbps         13 805 160.1Mbps
63 TOT    3          913 942 504.8Mbps        629 210 347.5Mbps        284 732 157.2Mbps
64 TOT    4          913 939 504.8Mbps        898 374 496.2Mbps         15 565   8.5Mbps
65 TOT    TOT      1 827 881 1009.6...      1 527 584 843.8Mbps        300 297 165.8Mbps

[admin@test-host] /tool traffic-generator stats stre
```

Port Stats

Sub-menu `/tool traffic-generator stats port`

This sub-menu stores statistics sorted by rx/tx ports.

```
[admin@test-host] /tool traffic-generator stats port> print
 # SEQ    PORT        RX-UNK-PACKET    RX-UNK-BYTE RX-UNK...     TX-PACKET   TX-RATE     RX-PACKET
 0 1      port0:et...             0              0      0bps        43 064 499.5Mbps        39 946
 1 1      port1:et...             0              0      0bps        43 062 499.5Mbps        25 180
 2 1      TOT                     0              0      0bps        86 126 999.0Mbps        65 126
 3 2      port0:et...             0              0      0bps        43 544 505.1Mbps        42 982
 4 2      port1:et...             0              0      0bps        43 543 505.0Mbps        30 449
 5 2      TOT                     0              0      0bps        87 087 1010.2...        73 431
 6 3      port0:et...             0              0      0bps        43 540 505.0Mbps        42 615
 7 3      port1:et...             0              0      0bps        43 540 505.0Mbps        30 191
 8 3      TOT                     0              0      0bps        87 080 1010.1...        72 806
```

Raw Stats

Sub-menu `/tool traffic-generator stats raw`

This sub-menu stores raw statistics data.

```
[admin@test-host] /tool traffic-generator stats raw> print
 # SEQ    PORT       NUM     TX-PACKET   TX-RATE     RX-PACKET   RX-RATE   LOST-PACKET LOST-RATE
 0 1      port0:e... 3          43 064 499.5Mbps             0      0bps        43 064 499.5Mbps
 1 1      port1:e... 3               0      0bps        25 180 292.0Mbps       -25 180 292.0Mbps
 2 1      TOT        3          43 064 499.5Mbps        25 180 292.0Mbps        17 884 207.4Mbps
 3 1      port0:e... 4               0      0bps        39 946 463.3Mbps       -39 946 463.3Mbps
 4 1      port1:e... 4          43 062 499.5Mbps             0      0bps        43 062 499.5Mbps
 5 1      TOT        4          43 062 499.5Mbps        39 946 463.3Mbps         3 116  36.1Mbps
 6 1      port0:e... TOT        43 064 499.5Mbps        39 946 463.3Mbps         3 118  36.1Mbps
 7 1      port1:e... TOT        43 062 499.5Mbps        25 180 292.0Mbps        17 882 207.4Mbps
 8 2      port0:e... 3          43 544 505.1Mbps             0      0bps        43 544 505.1Mbps
 9 2      port1:e... 3               0      0bps        30 449 353.2Mbps       -30 449 353.2Mbps
10 2      TOT        3          43 544 505.1Mbps        30 449 353.2Mbps        13 095 151.9Mbps
```

Streams

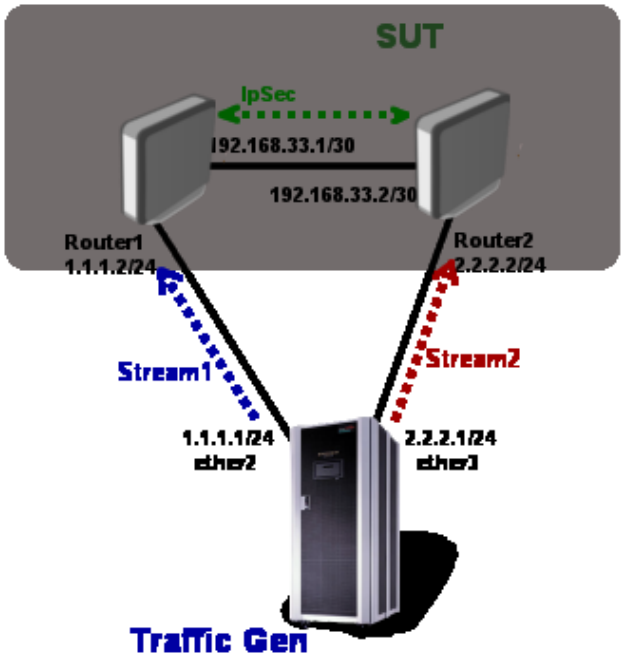
Properties

Property	Description
disabled (*yes* | *no*; Default: **no**)	Whether stream is disabled
mbps (*integer [0..4294967295]*; Default: **0**)	Value in Mega bits per second that stream will try to generate.
name (*string*; Default:)	Descriptive name of the stream.
num (*integer [0..15]*; Default: **0**)	
packet-size (*integer[1..65535] [-integer[1..65535]]*; Default: **0**)	Generated size of the packets in bytes. Can be set as the range for random packet size generation.
port (*string*; Default:)	Name of the port from Port menu that will be used to transmit packets.
pps (*integer [0..4294967295]*; Default: **0**)	Packets per second that stream will try to generate.
tx-template (*string*; Default:)	Name of the packet template from packet-template or raw-packet-template menus used as the packet content source.

Configuration Examples

IpSec tunnel performance test

Consider following test setup



System Under Test (SUT) consists of two routers connected to traffic generator server. Connection between both SUT routers are IPSec encrypted.

Traffic generator will run two streams:

- in direction from 1.1.1.0/24 network to 2.2.2.0/24 network
- in direction from 2.2.2.0/24 network to 1.1.1.0/24 network.

R1 routing and ipsec setup

```
/ip address
add address=192.168.33.1/30 interface=ether1
add address=1.1.1.2/24 interface=ether2

/ip route
add dst-address=2.2.2.0/24 gateway=192.168.33.2

/ip ipsec proposal
set default enc-algorithms=aes-128

/ip ipsec peer
add address=192.168.33.2 secret=123

/ip ipsec policy
add sa-src-address=192.168.33.1 sa-dst-address=192.168.33.2 \
    src-address=1.1.1.0/24 dst-address=2.2.2.0/24 tunnel=yes
```

R2 routing and ipsec setup

```
/ip address
add address=192.168.33.2/30 interface=ether1
add address=2.2.2.2/24 interface=ether2

/ip route
add dst-address=1.1.1.0/24 gateway=192.168.33.1

/ip ipsec proposal
set default enc-algorithms=aes-128

/ip ipsec peer
add address=192.168.33.1 secret=123

/ip ipsec policy
add sa-src-address=192.168.33.2 sa-dst-address=192.168.33.1 \
    src-address=2.2.2.0/24 dst-address=1.1.1.0/24 tunnel=yes
```

Traffig generator server setup

```
/ip address
add address=1.1.1.1/24 interface=ether2
add address=2.2.2.1/24 interface=ether3
```

First we will define which ports will be used as traffic generator tx/rx ports

```
/tool traffic-generator port
add disabled=no interface=ether2 name=port0
add disabled=no interface=ether3 name=port1
```

To construct actual packet that will be generated, packet-template is used.

```
/tool traffic-generator packet-template
add header-stack=mac,ip,udp ip-dst=2.2.2.1/32 ip-gateway=1.1.1.2 ip-src=1.1.1.1/32 \
    name=routing-1 port=port0
add header-stack=mac,ip,udp ip-dst=1.1.1.1/25 ip-gateway=2.2.2.2 ip-src=2.2.2.1/32 \
    name=routing-2 port=port1
```

Notice that mac addresses was not specified since template generator can assume next-hop mac address automatically by sending ARP messages. Since we are doing routing and destination IP is not directly reachable, we have set **ip-gateway** parameter to determine next-hop mac-address.

When running **print** you can see all assumed (detected) values including mac addresses.

```
[admin@test-host] /tool traffic-generator packet-template> print
 0 name="routing-1" header-stack=mac,ip,udp port=port0
   assumed-mac-dst=00:0C:42:00:38:9D assumed-mac-src=00:0C:42:40:94:25
   assumed-mac-protocol=ip assumed-ip-dscp=0 assumed-ip-id=0
   assumed-ip-frag-off=0 assumed-ip-ttl=64 assumed-ip-protocol=udp
   ip-src=1.1.1.1/32 ip-dst=2.2.2.1/32 assumed-udp-src-port=100
   assumed-udp-dst-port=200 ip-gateway=1.1.1.2 data=uninitialized data-byte=0

 1 name="routing-2" header-stack=mac,ip,udp port=port1
   assumed-mac-dst=00:0C:42:00:38:D1 assumed-mac-src=00:0C:42:40:94:26
   assumed-mac-protocol=ip assumed-ip-dscp=0 assumed-ip-id=0
   assumed-ip-frag-off=0 assumed-ip-ttl=64 assumed-ip-protocol=udp
   ip-src=2.2.2.1/32 ip-dst=1.1.1.1/32 assumed-udp-src-port=100
   assumed-udp-dst-port=200 ip-gateway=2.2.2.2 data=uninitialized data-byte=0
```

For example if any router in SUT change, assumed mac-addresses will not be updated automatically. To update packet templates simply issue command :

```
/tool traffic-generator packet-template set [find]
```

Last part is to configure streams

```
/tool traffic-generator stream
add disabled=no mbps=500 name=str1 num=3 packet-size=1450 port=port0 pps=0 \
    tx-template=routing-1
add disabled=no mbps=500 name=str3 num=4 packet-size=1450 port=port1 pps=0 \
    tx-template=routing-2
```

Notice that each stream has unique **num** value. This value identifies stream packets, otherwise traffic generator will not work.

Now we are ready to run the test. In this case **quick** mode will be used:

```
[admin@test-host] /tool traffic-generator> quick mbps=450
SEQ    NUM     TX-PACKET   TX-RATE     RX-PACKET   RX-RATE        RX-OOO   LOST-PACKET LOST-RATE
37     4          39 488 458.0Mbps        39 270 455.5Mbps        15 509           218   2.5Mbps
37     TOT        78 976 916.1Mbps        76 485 887.2Mbps        22 529         2 491  28.8Mbps
38     3          38 957 451.9Mbps        37 657 436.8Mbps         7 078         1 300  15.0Mbps
38     4          38 958 451.9Mbps        38 402 445.4Mbps        14 763           556   6.4Mbps
38     TOT        77 915 903.8Mbps        76 059 882.2Mbps        21 841         1 856  21.5Mbps
39     3          38 816 450.2Mbps        37 893 439.5Mbps         7 307           923  10.7Mbps
```

39	4	38	815	450.2Mbps	38	642	448.2Mbps	15 110	173	2.0Mbps
39	TOT	77	631	900.5Mbps	76	535	887.8Mbps	22 417	1 096	12.7Mbps
40	3	39	779	461.4Mbps	37	415	434.0Mbps	7 136	2 364	27.4Mbps
40	4	39	780	461.4Mbps	39	567	458.9Mbps	15 908	213	2.4Mbps
40	TOT	79	559	922.8Mbps	76	982	892.9Mbps	23 044	2 577	29.8Mbps
41	3	39	218	454.9Mbps	37	089	430.2Mbps	7 075	2 129	24.6Mbps
41	4	39	218	454.9Mbps	38	663	448.4Mbps	15 752	555	6.4Mbps
41	TOT	78	436	909.8Mbps	75	752	878.7Mbps	22 827	2 684	31.1Mbps
42	3	39	188	454.5Mbps	37	906	439.7Mbps	6 729	1 282	14.8Mbps
42	4	39	187	454.5Mbps	38	954	451.8Mbps	15 565	233	2.7Mbps
42	TOT	78	375	909.1Mbps	76	860	891.5Mbps	22 294	1 515	17.5Mbps
TOT	3	1 645	468	454.4Mbps	1 568	201	433.1Mbps	280 174	77 267	21.3Mbps
TOT	4	1 645	464	454.4Mbps	1 626	896	449.3Mbps	627 480	18 568	5.1Mbps
TOT	TOT	3 290	932	908.9Mbps	3 195	097	882.4Mbps	907 654	95 835	26.4Mbps

Stats shows throughput of each stream and total throughput of both streams, Out-of-order packet count, Lost rate, latency and jitter.

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Manual:Tools/Bandwidth Test

Applies to RouterOS: v2.9, v3, v4+

Summary

Sub-menu: `/tool`

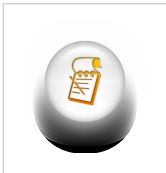
Packages required: `system`

The Bandwidth Tester can be used to measure the throughput to another MikroTik router (either wired or wireless) and thereby help to discover network "bottlenecks".

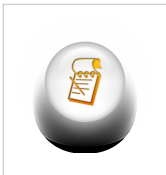
The TCP test uses the standard TCP protocol with acknowledgments and follows the TCP algorithm on how many packets to send according to latency, dropped packets, and other features in the TCP algorithm. Please review the TCP protocol for details on its internal speed settings and how to analyze its behavior. Statistics for throughput are calculated using the entire size of the TCP data stream. As acknowledgments are an internal working of TCP, their size and usage of the link are not included in the throughput statistics. Therefore this statistic is not as reliable as the UDP statistic when estimating throughput.

The UDP tester sends 110% or more packets than currently reported as received on the other side of the link. To see the maximum throughput of a link, the packet size should be set for the maximum MTU allowed by the links which is usually 1500 bytes. There is no acknowledgment required by UDP; this implementation means that the closest approximation of the throughput can be seen.

Warning: Bandwidth Test uses all available bandwidth (by default) and may impact network usability.



Note: Bandwidth Test uses a lot of resources. If you want to test real throughput of a router, you should run bandwidth test through the tested router not from or to it. To do this you need at least 3 routers connected in chain: the Bandwidth Server, the router being tested and the Bandwidth Client.



Note: If you use UDP protocol then Bandwidth Test counts IP header+UDP header+UDP data. In case if you use TCP then Bandwidth Test counts only TCP data (TCP header and IP header are not included).

Bandwidth Test Server

Sub-menu: `/tool bandwidth-server`

Property	Description
allocate-udp-ports-from (*integer 1000..64000*; Default: **2000**)	Beginning of UDP port range
authenticate (*yes* | *no*; Default: **yes**)	Communicate only with authenticated clients
enabled (*yes* | *no*; Default: **yes**)	Defines whether bandwidth server is enabled or not
max-sessions (*integer 1..1000*; Default: **100**)	Maximal simultaneous test count

Bandwidth Server:

```
[admin@MikroTik] /tool bandwidth-server> print
                  enabled: yes
             authenticate: yes
  allocate-udp-ports-from: 2000
             max-sessions: 100
[admin@MikroTik] /tool bandwidth-server>
```

Active sessions:

```
[admin@MikroTik] /tool bandwidth-server session> print
  # CLIENT          PROTOCOL DIRECTION USER
  0 35.35.35.1      udp      send      admin
  1 25.25.25.1      udp      send      admin
  2 36.36.36.1      udp      send      admin
[admin@MikroTik] /tool bandwidth-server session>
```

To enable **bandwidth-test** server without client authentication:

```
[admin@MikroTik] /tool bandwidth-server> set enabled=yes authenticate=no
[admin@MikroTik] /tool bandwidth-server> print
                  enabled: yes
             authenticate: no
  allocate-udp-ports-from: 2000
```

```
             max-sessions: 100
[admin@MikroTik] /tool bandwidth-server>
```

Bandwidth Test Client

Command name: `/tool bandwidth-test`

Property	Description
address (*IP address* | *IPv6 prefix[%interface]*; Default:)	IP address of host
direction (*both* | *receive* | *transmit*; Default: **receive**)	Direction of data flow
duration (*time*; Default:)	Duration of the test
interval (*time: 20ms..5s*; Default: **1s**)	Delay between reports (in seconds)
local-tx-speed (*integer 0..4294967295*; Default:)	Transfer test maximum speed (bits per second)
local-udp-tx-size (*integer: 28..64000*)	Local transmit packet size in bytes
password (*string*; Default: "")	Password for the remote user
protocol (*udp* | *tcp*; Default: **udp**)	Protocol to use
random-data (*yes* | *no*; Default: **no**)	If random-data is set to yes, the payload of the bandwidth test packets will have incompressible random data stream so that links that use data compression will not distort the results (this is CPU intensive and random-data should be set to no for low speed CPUs)
remote-tx-speed (*integer 0..4294967295*; Default:)	Receive test maximum speed (bits per second)
remote-udp-tx-size (*integer: 28..64000*)	Remote transmit packet size in bytes
tcp-connection-count (*integer 1..100*; Default: **20**)	Number of TCP connections to use
user (*string*; Default: "")	Remote user

Example

To run 15-second long bandwidth-test to the **10.0.0.32** host sending and receiving **1000**-byte UDP packets and using username **admin** to connect:

```
[admin@MikroTik] /tool> bandwidth-test 10.0.0.32 duration=15s \
\... direction=both local-udp-tx-size=1000 protocol=udp \
\... remote-udp-tx-size=1000 user=admin
                status: done testing
              duration: 15s
            tx-current: 272.8Mbps
  tx-10-second-average: 200.3Mbps
      tx-total-average: 139.5Mbps
            rx-current: 169.6Mbps
  rx-10-second-average: 164.8Mbps
      rx-total-average: 117.0Mbps
```

```
          lost-packets: 373
           random-data: no
             direction: both
               tx-size: 1000
               rx-size: 1000
[admin@MikroTik] /tool>
```

Link-local IPv6 example:

```
[admin@dzeltenais_burkaans] > /tool bandwidth-test fe80::34:23ff:fe6a:570c%local

                 status: running
               duration: 5s
             rx-current: 23.9Mbps
  rx-10-second-average: 15.1Mbps
      rx-total-average: 15.1Mbps
          lost-packets: 0
           random-data: no
             direction: receive
               rx-size: 1500
```

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Manual:System/Note

Applies to RouterOS: v3, v4, v5

Summary

Sub-menu level: `/system note`

System note feature allows you to assign arbitrary text notes or messages that will be displayed on each login right after banner. For example, you may distribute warnings between system administrators this way, or describe what does that particular router actually do. To configure system note, you may upload a plain text file named **sys-note.txt** on the router's FTP server, or, additionally, edit the settings in this menu

Properties

Property	Description
note (*string*; Default:)	Note that will be displayed.
show-at-login (*yes* | *no*; Default: **yes**)	whether to show system note on each login

Example

It is possible to add multi-line notes using embedded text editor (*/system note edit note*), for example add ASCII art to your home router:

```
[admin@RB493G] /system note> edit note

                            (   )
                           (    )
                            (    )
                           (    )
                             )  )
                            (  (                    /\
                              (_)                  /  \  /\
                     _________[_]_________       /\/    \/  \
           /\       /\         _______     \    /   /\/\  /\/\
          /  \    //_\        \    /\    \  /\/\/    \/    \
   /\    / /\/\  //___\        \__/  \    \/
  /  \  /\/    \//_____\        \ |[]|     \
 /\/\/\/       //_______\        \|__|      \
/      \      /XXXXXXXXXX\                    \
        \    /_I_II  I__I_\_____________________\
               I_I|  I__I_____[]_|_[]_____I
               I_II  I__I_____[]_|_[]_____I
               I II__I  I     XXXXXXX     I
            ~~~~~"   "~~~~~~~~~~~~~~~~~~~~~

C-c quit C-o save&quit C-u undo C-k cut line C-y paste F5 repaint
```

Save changes by pressing **Ctrl+o**. Now next time you log in, console will print your piece of art:

```
  MMMM    MMMM       KKK                          TTTTTTTTTTT      KKK
  MMM MMMM MMM  III  KKK  KKK  RRRRRR     OOOOOO      TTT     III  KKK  KKK
  MMM  MM  MMM  III  KKKKK     RRR  RRR  OOO  OOO     TTT     III  KKKKK
  MMM      MMM  III  KKK KKK   RRRRRR    OOO  OOO     TTT     III  KKK KKK
  MMM      MMM  III  KKK  KKK  RRR  RRR   OOOOOO      TTT     III  KKK  KKK

  MikroTik RouterOS 5.3 (c) 1999-2011       http://www.mikrotik.com/
```

```
                            (   )
                           (     )
                            (     )
                           (     )
                             )   )
                            (   (                    /\
                              (_)                   /  \  /\
                     _________[_]_________       /\/    \/  \
           /\       /\         _______     \    /   /\/\  /\/\
          /  \     //_\        \     /\     \  /\/\/    \/    \
   /\    / /\/\  //___\        \__/  \     \/
  /  \  /\/    \//_____\        \ |[]|     \
 /\/\/\/        //_______\        \|__|      \
/       \       /XXXXXXXXXX\                    \
         \     /_I_II  I__I_\____________________\
                I_I|  I__I_____[]_|_[]_____I
                I_II  I__I_____[]_|_[]_____I
                I II__I  I     XXXXXXX      I
             ~~~~~"   "~~~~~~~~~~~~~~~~~~~~~~~~
[admin@RB493G] >
```

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Manual:System/File

Applies to RouterOS: v3, v4 +

Summary

Sub-menu level: `/file`

File menu shows all user space files on the router. It is possible to see and edit file content or delete file. file creation is not possible from this menu, to create files see scripting examples for workaround.

If RouterOS ".npk" package is uploaded, file menu will also show package specific information, like architecture, build date and time, etc.

File content example:

```
[admin@dzeltenais_burkaans] /file> print
 # NAME                          TYPE                   SIZE                CREATION-TIME
 0 autosupout.rif                .rif file              357368              oct/05/2010 09:47:01
 1 sample.txt                    .txt file              230                 oct/11/2010 12:14:43
[admin@dzeltenais_burkaans] /file> set 1 contents=Hello

[admin@dzeltenais_burkaans] /file> print detail where name~"sample"
```

```
 1 name="sample.txt" type=".txt file" size=5 creation-time=oct/11/2010 12:15:38 contents=Hello
[admin@dzeltenais_burkaans] /file>
```

Package example:

```
[admin@493G] /file> print detail
 0 name="multicast-5.0rc2-mipsbe.npk" type="package" size=245643 creation-time=jan/05/1970 21:44:25
   package-name="multicast" package-version="5.0rc2" package-build-time=oct/11/2010 06:34:02
   package-architecture="mips"
```

Properties

Property	Description
contents (*string*; Default:)	Actual content of the file.

Read-only properties

Property	Description
creation-time (*time*)	Time when file was created
name (*string*)	Name of the file
package-architecture (*string*)	Architecture that package is built for. Applies only to RouterOS ".npk" files.
package-built-time (*string*)	Time when package was built. Applies only to RouterOS ".npk" files.
package-name (*string*)	Name of the installable package that. Applies only to RouterOS ".npk" files.
package-version (*string*)	version of the installable package that. Applies only to RouterOS ".npk" files.
size (*integer*)	File size in bytes
file type (*string*)	Type of the file. For folders file type is *directory*

read more

- Scripting examples
- RouterOS upgrade

Manual:System/Resource

Applies to RouterOS: v3, v4 +

General

Sub-menu level: `/system resource`

General resource menu shows overall resource usage and router statistics like uptime, memory usage, disk usage, version etc.

It also has several sub-menus for more detailed hardware statistics like PCI, IRQ and USB.

```
[admin@RB1100test] /system resource> print
                   uptime: 2w1d23h34m57s
                  version: "5.0rc1"
             free-memory: 385272KiB
            total-memory: 516708KiB
                      cpu: "e500v2"
                cpu-count: 1
            cpu-frequency: 799MHz
                 cpu-load: 9%
           free-hdd-space: 466328KiB
          total-hdd-space: 520192KiB
  write-sect-since-reboot: 1411
         write-sect-total: 70625
               bad-blocks: 0.2%
        architecture-name: "powerpc"
               board-name: "RB1100"
                 platform: "MikroTik"
```

Properties

All properties are read-only

Property	Description
architecture-name (*string*)	CPU architecture. Can be *powerpc*, *x86*, *mipsbe* or *mipsle*.
bad-blocks (*percent*)	Shows percentage of bad blocks on the NAND.
board-name (*string*)	RouterBOARD model name
cpu (*string*)	Cpu model that is on the board.
cpu-count (*integer*)	Number of CPUs present on the system. Each core is separate CPU, Intel HT is also separate CPU.
cpu-frequency (*string*)	Current CPU frequency.
cpu-load (*percent*)	Percentage of used CPU resources. Combines all CPUs. Per-core CPU usage can be see in CPU submenu
free-hdd-space (*string*)	Free space on hard drive or NAND

free-memory (*string*)	Unused amount of RAM
platform (*string*)	Platform name, usually it is "MikroTik"
total-hdd-space (*string*)	Size of the hard drive or NAND
total-memory (*string*)	Amount of installed RAM
uptime (*time*)	Time interval passed since boot-up.
version (*string*)	Installed RouterOS version number.
write-sect-since-reboot (*integer*)	Number of sector writes in HDD or nand since router was last time rebooted.
write-sect-total (*integer*)	Number of sector writes in total.

CPU

Sub-menu level: `/system resource cpu`

This submenu shows per-cpu usage, as long as IRQ and Disk usage.

```
[admin@RB1100test] /system resource cpu> print
CPU LOAD         IRQ          DISK
0   5%           0%           0%
[admin@RB1100test] /system resource cpu>
```

(needs editing)

Properties

Read-only properties

Property	Description
cpu (*integer*)	Identification number of CPU which usage is shown.
load (*percent*)	CPU usage in percents
irq (*percent*)	IRQ usage in percents
disk (*percent*)	Disk usage in percents

IRQ

Sub-menu level: `/system resource irq`

Menu shows all used IRQs on the router. It is possible to set up IRQ load balancing on mulicore systems by assigning IRQ to specific core. IRQ assignments are done by hardware and cannot be changed from RouterOS. For example, if all Ethernets are assigned to one IRQ, then you have to deal with hardware: upgrade motherboards BIOS, reassign IRQs manually in BIOS, if none of above helps then change the hardware.

Properties

Property	Description
cpu (*auto* | *integer*; Default:)	Specifies which CPU is assigned to the IRQ. • **auto** - pick CPU based on number of interrupts. Uses NAPI [1] to optimize interrupts.

Read-only properties

Property	Description
active-cpu (*integer*)	Shows active CPU in multicore systems.
count (*integer*)	Number of interrupts. On ethernet interfaces interrupt=packet.
irq (*integer*)	IRQ identification number
users (*string*)	Process assigned to IRQ

RPS

Sub-menu level: `/system resource rps`

This menu allows to enable Receive Packet Steering (RPS) to reduce single core usage.

NAPI [1] can become a bottleneck under high packet load, because of serialization per device queue. RPS distributes the load of received packet processing across multiple cores.

USB

Sub-menu level: `/system resource usb`

This menu displays all available USB controllers on the board. Menu is available only if at least one USB controller is present.

```
[admin@MikroTik] /system resource usb> print detail
 0 device="2:1" name="RB400 EHCI" serial-number="rb400_usb" vendor-id="0x1d6b"
   device-id="0x0002" speed="480 Mbps" ports=2 usb-version="2.00"

 1 device="1:1" name="RB400 OHCI" serial-number="rb400_usb" vendor-id="0x1d6b"
   device-id="0x0001" speed="12 Mbps" ports=2 usb-version="1.10"
```

Properties

Property	Description
device (*string*)	
device-id (*hex*)	Hexadecimal device ID
name (*string*)	Descriptive name of the device retrieved from driver
ports (*integer*)	How many ports are supported by usb controller
serial-number (*string*)	
speed (*string*)	Max USB speed that can be used (480Mbps for USBv2 and 12Mbps for USBv1)
usb-version (*string*)	Identifies max spported USB version
vendor (*string*)	Device manufacturer's name.

vendor-id (*hex*)	Hexadecimal vendor ID	

PCI

Sub-menu level: `/system resource pci`

PCI submenu shows the information about all PCI devices on the board

```
[admin@RB1100test] /system resource pci> print
 # DEVICE   VENDOR                        NAME                         IRQ
 0 06:00.0  Attansic Technology Corp.     unknown device (rev: 192)  18
 1 05:00.0  Freescale Semiconductor Inc   MPC8544 (rev: 17)          0
 2 04:00.0  Attansic Technology Corp.     unknown device (rev: 192)  17
 3 03:00.0  Freescale Semiconductor Inc   MPC8544 (rev: 17)          0
 4 02:00.0  Attansic Technology Corp.     unknown device (rev: 192)  16
 5 01:00.0  Freescale Semiconductor Inc   MPC8544 (rev: 17)          0
 6 00:00.0  Freescale Semiconductor Inc   MPC8544 (rev: 17)          0
```

Properties

All properties are read-only

Property	Description
category (*string*)	PCI device type, for example *ethernet controller*
device (*string*)	
device-id (*hex*)	Hexadecimal device ID
io (*hex-hex*)	I/O memory range
irq (*integer*)	IRQ asigned to the device
memory (*hex-hex*)	Memory range
name (*string*)	Descriptive name of the device retrieved from driver
vendor (*string*)	Device manufacturer's name.
vendor-id (*hex*)	Hexadecimal vendor ID

References

[1] http://www.linuxfoundation.org/collaborate/workgroups/networking/napi

Manual:System/Health

Summary

Hardware that supports monitoring will display different information about hardware status, like temperature, voltage.

Warning: For feature availablity on RouterBOARD products check routerboard.com [1]

Voltage

Routers that support voltage monitoring will display supplied voltage value. In CLI/Winbox it will display volts. In scripts/API/SNMP this will be dV or value showed in CLI/Winbox multiplied by 10

Note: Routers that have PEXT and PoE power input are calibrated using PEXT, as result value showed over PoE can be lower than input voltage due to additional ethernet protection chains.

Temperature

Routers that support temperature monitoring will display temperature reading. In CLI/Winbox it will display degrees Celsius. In scripts/API/SNMP this will be value showed in CLI/Winbox multiplied by 10

Fan control

Using this menu users will be able to control fan behaviour on the router.

Warning: for *auto* mode to work you have to use fans that support monitoring (it will have 3 wires) If you have fan with only 2 wires (V+,GND) then you have to set fan-mode to manual. If control pulse cannot be detected, then router will switch between main and auxiliary fan and stop only when it detects fan with control

References

[1] http://routerboard.com

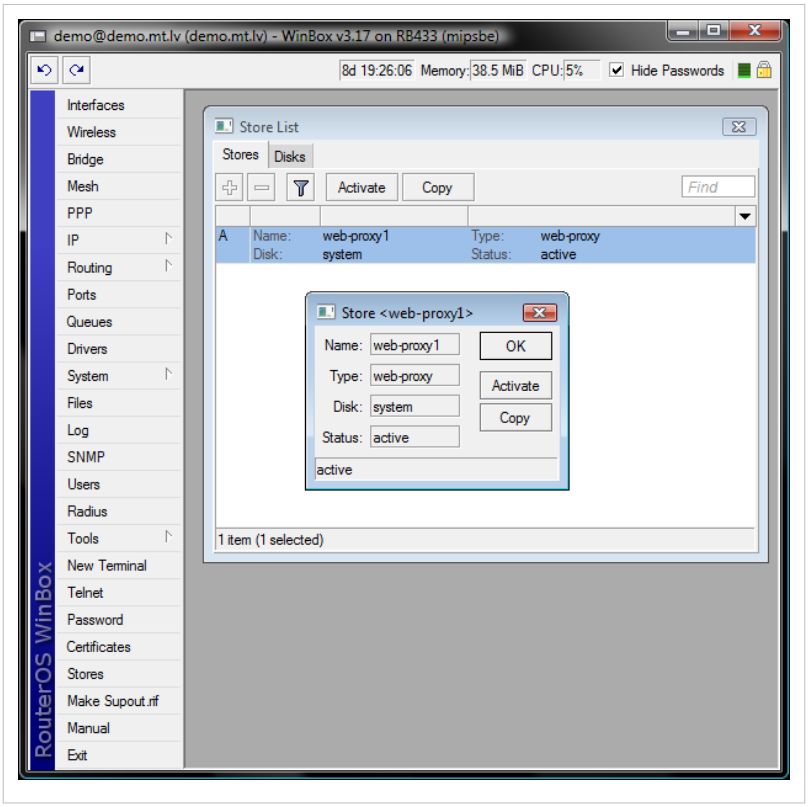
Manual:Store

Applies to RouterOS: v3, v4+

Store manages storage devices used by RouterOS various facilities.

Currently Store can be used for:

- **Webproxy**
- **User Manager**
- **the Dude**



This is especially useful for RouterBOARD devices with **SD/CF** slots - as the built-in storage is quite small, an external drive comes in very handy when you want a big User Manager database.

You can add as many external or secondary drives as you want, and select any number of them for each of the mentioned feature use. For example User Manager could be used on 3 disks, one of them would be the active database, and the rest would be backups. You can then add a fourth disk, copy the active data to it - unplug it - and move to another server, to keep using the actual database.

This means migration and backup made easy!

Note: For proper operation router needs to be rebooted after adding or removing external storage.

Creating a Store instance

```
[normis@demo.mt.lv] /store> print
Flags: X - disabled, A - active
 #    NAME                      TYPE                      DISK                      STATUS
 0 A web-proxy1                 web-proxy                 system                    active
[normis@demo.mt.lv] /store> add
 activate  comment  copy-from  disabled  name  disk  type

[normis@demo.mt.lv] /store> add name=webproxy_backup disk=disk1 type=web-proxy activate=no
```

This will add a new storage place for Webproxy on disk1, and will set it as inactive.

Activate new store instance to save proxy cache on secondary disk (other proxy settings configured separately from **/ip proxy menu**),

```
[normis@demo.mt.lv] > store activate webproxy-backup
```

E.g. RB1000 with populated CF Card slot and User Manager, one can add the CF card for use by User manager to store all it's data as follows

```
/store add disk=CF1 type=user-manager activate=yes
```

Store management

Sub-menu: `/store`

Properties

Property	Description
activate (*yes* | *no*; Default: **no**)	Whether to activate this store as primary.
comment (*string*; Default:)	Short description of an item.
disabled (*yes* | *no*; Default: **no**)	Whether to disable store.
disk (*string*; Default:)	Name of the disk (from `/store disk` menu) used by this store.
name (*string*; Default:)	Descriptive name of the store
type (*user-manager* | *web-proxy*; Default:)	Configured type of the store. Two options are available, either store is used by web-proxy or by user-manager.

Read-only Properties

Property	Description
status (*backup* | *active* | *invalid*)	Current status of the store. Shows whether store is used as backup,active or some of the config is invalid.

Menu specific commands

Property	Description
activate (<*store_name*>)	Makes specified store as active if previously was in backup state.

Disk management

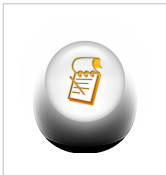
Sub-menu: `/store disk`

Read-only Properties

Property	Description
free-space (*integer [KiB]*)	Shows the free space left on the disk.
name (*string*)	Name of the disk
status (*strung*)	Shows the current status of the disk, can be **ready**, **formating** etc.
system (*yes* | *no*)	Shows whether disk is used as system drive
total-space (*integer [KiB]*)	Shows total available disk space

Menu specific commands

Property	Description
check-drive (<*drive_name*>)	Check the drive for errors.
clean-drive (<*drive_name*>)	Clean the drive
format-drive (<*drive_name*>)	Format the file system in usable by RouterOS file system.



Note: Before using drive as a storage device it must be formatted. Before doing so, make sure that all sensitive data is backed up.

Manual:System/Watchdog

Applies to RouterOS: v3, v4 +

Summary

This menu allows to configure system to reboot on kernel panic, when an IP address does not respond, or in case the system has locked up. Software watchdog timer is used to provide the last option, so in very rare cases (caused by hardware malfunction) it can lock up by itself. There is a hardware watchdog device available in all RouterBOARD PowerPC and Mipsbe models, which can reboot the system in any case.

Properties

Sub-menu: `/system watchdog`

Property	Description
watch-address (*IP*; Default: **none**)	The system will reboot in case 6 sequental pings to the given IP address (sent once per 10 seconds) will fail. If set to **none** this feature is disabled.
watchdog-timer (*yes* | *no*; Default: **yes**)	Whether to reboot if system is unresponsive for a minute
no-ping-delay (*time*; Default: **5m**)	Specifies how long after reboot not to test and ping watch-address. The default setting means that if watch-address is set and is not reachable, the router will reboot about every 6 minutes.
automatic-supout (*yes* | *no*; Default: **yes**)	When software failure happens, a file named "autosupout.rif" is generated automatically. The previous "autosupout.rif" file is renamed to "autosupout.old.rif"
auto-send-supout (*yes* | *no*; Default: **no**)	After the support output file is automatically generated, it can be sent by email
send-email-from (*string*; Default:)	e-mail address to send the support output file from. If not set, the value set in /tool e-mail is used
send-email-to (*string*; Default:)	e-mail address to send the support output file to.
send-smtp-server (*string*; Default:)	SMTP server address to send the support output file through. If not set, the value set in /tool e-mail is used.

Basic examples

To make system generate a support output file and sent it automatically to support@example.com throught the 192.0.2.1in case of a software crash:

```
[admin@MikroTik] system watchdog> set auto-send-supout=yes \
\... send-to-email=support@example.com send-smtp-server=192.0.2.1
[admin@MikroTik] system watchdog> print
      watch-address: none
     watchdog-timer: yes
      no-ping-delay: 5m
   automatic-supout: yes
   auto-send-supout: yes
   send-smtp-server: 192.0.2.1
      send-email-to: support@example.com
[admin@MikroTik] system watchdog>
```

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Manual:System/Scheduler

Applies to RouterOS: 2.9, v3, v4

Summary

The scheduler can trigger script execution at a particular time moment, after a specified time interval, or both.

Properties

- **interval** *(time; default: 0s)* - interval between two script executions, if time interval is set to zero, the script is only executed at its start time, otherwise it is executed repeatedly at the time interval is specified
- **name** *name)* - name of the task
- **on-event** *(name)* - name of the script to execute. It must be presented at /system script
- **run-count** *(read-only: integer)* - to monitor script usage, this counter is incremented each time the script is executed
- **start-date** *(date)* - date of the first script execution
- **start-time** *(time)* - time of the first script execution
- **startup** - execute the script 3 seconds after the system startup.

Notes

Rebooting the router will reset run-count counter.

If more than one script has to be executed simultaneously, they are executed in the order they appear in the scheduler configuration. This can be important if one scheduled script is used to disable another one. The order of scripts can be changed with the move command.

If a more complex execution pattern is needed, it can usually be done by scheduling several scripts, and making them enable and disable each other.

if scheduler item has start-time set to startup, it behaves as if start-time and start-date were set to time 3 seconds after console starts up. It means that all scripts having start-time=startup and interval=0 will be executed once each time router boots.

Examples

We will add a task that executes the script log-test every hour:

```
[admin@MikroTik] system script> add name=log-test source=:log message=test
[admin@MikroTik] system script> print
    0 name="log-test" source=":log messgae=test" owner=admin run-count=0
[admin@MikroTik] system script> .. scheduler
[admin@MikroTik] system scheduler> add name=run-1h interval=1h
on-event=log-test
[admin@MikroTik] system scheduler> print

Flags: X - disabled
```

```
 #   NAME      ON-EVENT  START-DATE  START-TIME INTERVAL     RUN-COUNT
 0   run-1h    log-test  mar/30/2004 06:11:35   1h           0
[admin@MikroTik] system scheduler>
```

In another example there will be two scripts added that will change the bandwidth setting of a queue rule "Cust0". Every day at 9AM the queue will be set to 64Kb/s and at 5PM the queue will be set to 128Kb/s. The queue rule, the scripts, and the scheduler tasks are below:

```
 [admin@MikroTik] queue simple> add name=Cust0 interface=ether1 \
\... dst-address=192.168.0.0/24 limit-at=64000
[admin@MikroTik] queue simple> print
Flags: X - disabled, I - invalid
  0   name="Cust0" target-address=0.0.0.0/0 dst-address=192.168.0.0/24
      interface=ether1 limit-at=64000 queue=default priority=8 bounded=yes

[admin@MikroTik] queue simple> /system script
[admin@MikroTik] system script> add name=start_limit source={/queue simple set \
\... Cust0 limit-at=64000}
[admin@MikroTik] system script> add name=stop_limit source={/queue simple set \
\... Cust0 limit-at=128000}
[admin@MikroTik] system script> print
  0 name="start_limit" source="/queue simple set Cust0 limit-at=64000"
    owner=admin run-count=0

  1 name="stop_limit" source="/queue simple set Cust0 limit-at=128000"
    owner=admin run-count=0

[admin@MikroTik] system script> .. scheduler
[admin@MikroTik] system scheduler> add interval=24h name="set-64k" \
\... start-time=9:00:00 on-event=start_limit
[admin@MikroTik] system scheduler> add interval=24h name="set-128k" \
\... start-time=17:00:00 on-event=stop_limit
[admin@MikroTik] system scheduler> print
Flags: X - disabled
  #   NAME      ON-EVENT START-DATE  START-TIME INTERVAL             RUN-COUNT
  0   set-64k   start... oct/30/2008 09:00:00   1d                   0
  1   set-128k  stop_... oct/30/2008 17:00:00   1d                   0
[admin@MikroTik] system scheduler>
```

The following example schedules a script that sends each week a backup of router configuration by e-mail.

```
[admin@MikroTik] system script> add name=e-backup source={/system backup
{... save name=email; /tool e-mail send to="root@host.com" subject=([/system
{... identity get name] . " Backup") file=email.backup}
[admin@MikroTik] system script> print
  0 name="e-backup" source="/system backup save name=ema... owner=admin
    run-count=0

[admin@MikroTik] system script> .. scheduler
```

```
[admin@MikroTik] system scheduler> add interval=7d name="email-backup" \
\... on-event=e-backup
[admin@MikroTik] system scheduler> print
Flags: X - disabled
  #   NAME      ON-EVENT START-DATE  START-TIME INTERVAL            RUN-COUNT
  0   email-... e-backup oct/30/2008 15:19:28   7d                  1
[admin@MikroTik] system scheduler>
```

Do not forget to set the e-mail settings, i.e., the SMTP server and From: address under /tool e-mail. For example:

```
[admin@MikroTik] tool e-mail> set server=159.148.147.198 from=SysAdmin@host.com
[admin@MikroTik] tool e-mail> print
    server: 159.148.147.198
      from: SysAdmin@host.com
[admin@MikroTik] tool e-mail>
```

Example below will put 'x' in logs each hour from midnight till noon:

```
[admin@MikroTik] system script> add name=enable-x source={/system scheduler
{... enable x}
[admin@MikroTik] system script> add name=disable-x source={/system scheduler
{... disable x}
[admin@MikroTik] system script> add name=log-x source={:log message=x}
[admin@MikroTik] system script> .. scheduler
[admin@MikroTik] system scheduler> add name=x-up start-time=00:00:00 \
\... interval=24h on-event=enable-x
[admin@MikroTik] system scheduler> add name=x-down start-time=12:00:00
\... interval=24h on-event=disable-x
[admin@MikroTik] system scheduler> add name=x start-time=00:00:00 interval=1h \
\... on-event=log-x
[admin@MikroTik] system scheduler> print
Flags: X - disabled
  #   NAME      ON-EVENT START-DATE  START-TIME INTERVAL            RUN-COUNT
  0   x-up      enable-x oct/30/2008 00:00:00   1d                  0
  1   x-down    disab... oct/30/2008 12:00:00   1d                  0
  2   x         log-x    oct/30/2008 00:00:00   1h                  0
[admin@MikroTik] system scheduler>
```

Manual:System/Time

Applies to RouterOS: v3, v4

Clock and Time zone configuration

RouterOS uses data from the tz database [1], Most of the time zones from this database are included, and have the same names. Because local time on the router is used mostly for timestamping and time-dependant configuration, and not for historical date calculations, time zone information about past years is not included. Currently only information starting from 2005 is included.

Following settings are available in the **/system clock** console path, and in the "Time" tab of the "System > Clock" WinBox window:

- **time** (*HH:MM:SS*, where *HH* - hour 00..24, *MM* - minutes 00..59, *SS* - seconds 00..59)
- **date** (*mmm/DD/YYYY*, where *mmm* - month, one of *jan*, *feb*, *mar*, *apr*, *may*, *jun*, *jul*, *aug*, *sep*, *oct*, *nov*, *dec*, *DD* - date, 00..31, *YYYY* - year, 1970..2037) : **date** and **time** show current local time on the router. These values can be adjusted using the **set** command. Local time cannot, however, be exported, and is not stored with the rest of the configuration.
- **time-zone-name** (*manual*, or name of time zone; default value: *manual*) : Name of time zone. Like most of the text values in RouterOS, this value is case sensitive. Special value *manual* applies manually configured GMT offset, which by default is *00:00* with no daylight saving time.

Startup date and time is *jan/02/1970 00:00:00 [+|-]gmt-offset*. If router has a battery (for example RB230), then BIOS stored time is used as a startup time.

Active time zone information

- **dst-active** (*yes* or *no*>; read-only property) : This property has value *yes* while daylight saving time of the current time zone is active.
- **gmt-offset** ([+|-]*HH:MM* - offset in hours and minutes; read-only property) : This is the current value of GMT offset used by the system, after applying base time zone offset and active daylight saving time offset.

Manual time zone configuration

These settings are available in **/system clock manual** console path, and in the "Manual Time Zone" tab of the "System > Clock" WinBox window. These settings have effect only when **time-zone-name=***manual*. It is only possible to manually configure single daylight saving time period.

- **time-zone**, **dst-delta** ([+|-]*HH:MM* - time offset in hours and minutes, leading plus sign is optional; default value: *+00:00*) : While DST is not active use GMT offset **time-zone**. While DST is active use GMT offset **time-zone** + **dst-delta**.
- **dst-start**, **dst-end** (*mmm/DD/YYYY HH:MM:SS* - date and time, either date or time can be ommited in the **set** command; default value: *jan/01/1970 00:00:00*) : Local time when DST starts and ends.

SNTP client

SNTP client is included in the *system* package. RouterOS implements SNTP protocol defined in RFC4330. Manycast mode is not supported. NTP server and a NTP client is included in the separate *ntp* package, that is not installed by default.

Client configuration is located in the **/system ntp client** console path, and the "System > NTP Client" WinBox window. This configuration is shared by the SNTP client implementation in the *system* package and the NTP client implementation in the *ntp* package. When *ntp* package is installed and enabled, the SNTP client is disabled automatically.

- **enabled** (*yes* or *no*; default value: *no*)
- **mode** (One of *broadcast* or *unicast*; default value: *broadcast*) : In broadcast mode, client does not send any requests, and listens for the broadcast messages sent by the NTP server. In unicast mode client periodically sends requests to the currently selected active server, and waits for a reply message from that server.
- **primary-ntp**, **secondary-ntp** (IP address) : IP addresses of the NTP servers. These properties have effect only when **mode**=*unicast*. Value *0.0.0.0* is ignored. If both values are zero and **mode** is *unicast* then SNTP client is disabled. If both values are non-zero, then SNTP client will alternate between the two server addresses, switching to the other when request to the current server times out or when the "KoD" packet is received, indicating that server is not willing to respond to requiests from this client.

Status

- **active-server** (IP address; read-only property) : Currently selected NTP server address. This value is equal to **primary-ntp** or **secondary-ntp**.
- **poll-interval** (Time interval; read-only property) : Current iterval between requests sent to the active server. Initial value is 16 seconds, and it is increased by doubling to 15 minutes.

Last received packet information

Values of the following properties are reset when the SNTP client is stopped or restarted, either because of a configuration change, or because of a network error.

- **last-update-from** (IP address; read-only property) : Source IP address of the last received NTP server packed that was successfully processed.
- **last-update-before** (Time interval; read-only property) : Time since the last successfully received server message.
- **last-adjustment** (Time interval; read-only property) : Amount of clock adjustment that was calculated from the last successfully received NTP server message.
- **last-bad-packet-from** (IP address; read-only property) : Source IP address of last received SNTP packed that was not successfully processed. Reason of the failure and time since this packet was received is available in the next two properties.
- **last-bad-packet-before** (Time interval; read-only property) : Time since the last receive failure.
- **last-bad-packet-reason** (Text; read-only property) : Text that describes reason of the last receive failure. Possible values are:
  - *bad-packet-length* - Packet length is not in the acceptable range.
  - *server-not-synchronized* - Leap Indicator field is set to "alarm condition" value, which means that clock on the server has not been synchronized yet.
  - *zero-transmit-timestamp* - Transmit Timestamp field value is 0.
  - *bad-mode* - Value of the Mode field is neither 'server' nor 'broadcast'.

- *kod-ABCD* - Received "KoD" (Kiss-o'-Death) response. *ABCD* is the short "kiss code" text from the Reference Identifier field.
- *broadcast* - Received proadcast message, but **mode=***unicast*.
- *non-broadcast* - Received packed was server reply, but **mode=***broadcast*.
- *server-ip-mismatch* - Received response from address that is not **active-server**.
- *originate-timestamp-mismatch* - Originate Timestamp field in the server response message is not the same as the one included in the last request.
- *roundtrip-too-long* - request/response roundtrip exceeded 1 second.

Log messages

SNTP client can produce the following log messages. See article "log" on how to set up logging and how to inspect logs.

- **ntp**,**debug** gradually adjust by *OFFS*
- **ntp**,**debug** instantly adjust by *OFFS*
- **ntp**,**debug** Wait for *N* seconds before sending next message
- **ntp**,**debug** Wait for *N* seconds before restarting
- **ntp**,**debug**,**packet** packet receive error, restarting
- **ntp**,**debug**,**packet** received *PKT*
- **ntp**,**debug**,**packet** ignoring received *PKT*
- **ntp**,**debug**,**packet** error sending to *IP*, restarting
- **ntp**,**debug**,**packet** sending to *IP PKT*

Explanation of log message fields

- *OFFS* - difference of two NTP timestamp values, in hexadecimal.
- *PKT* - dump of NTP packet. If packet is shorter than the minimum 48 bytes, it is dumped as a hexadecimal string. Otherwise, packet is dumped as a list of field names and values, one per log line. Names of fields follow RFC4330.
- *IP* - remote IP address.

NOTE: the above logging rules work only with the built-in SNTP client, the separate NTP package doesn't have any logging facilities.

NTP client and server

To use NTP client and server, *ntp* package must be installed and enabled.

Client settings

Client configuration is located in **/system ntp client**.

- **enabled** (*yes* or *no*; default value: *no*)
- **mode** (One of *broadcast*, *unicast*, *multicast* or *manycast*.)
- **primary-ntp**, **secondary-ntp** (IP address)

References

[1] http://www.twinsun.com/tz/tz-link.htm

Manual:API

Summary

Application Programmable Interface (API) allows users to create custom software solutions to communicate with RouterOS to gather information, adjust configuration and manage router. API closely follows syntax from command line interface (CLI). It can be used to create translated or custom configuration tools to aid ease of use running and managing routers with RouterOS.

To use API RouterOS version 3.x or newer is required.

By default API uses port *#8728* and service is disabled. More on service management see in corresponding manual section. Corresponding service name is **api**

Protocol

Communication with router is done by sending sentences to the router and receiving one or more sentences in return. Sentence is sequence of words terminated by zero length word. Word is part of sentence encoded in certain way - encoded length and data. Communication happen by sending sentences to the router and receiving replies to sent sentences. Each sentence sent to router using API should contain command as a first word followed by words in no particular order, end of sentence is marked by zero length word. When router receives full sentence (command word, no or more attribute words and zero length word) it is evaluated and executed, then reply is formed and returned.

API words

Words are part of sentence. Each word has to be encoded in certain way - length of the word followed by word content. Length of the word should be given as count of bytes that are going to be sent.

Length of the word is encoded as follows:

Value of length	# of bytes	Encoding
0 <= len <= 0x7F	1	len, lowest byte
0x80 <= len <= 0x3FFF	2	len | 0x8000, two lower bytes
0x4000 <= len <= 0x1FFFFF	3	len | 0xC00000, three lower bytes
0x200000 <= len <= 0xFFFFFFF	4	len | 0xE0000000
len >= 0x10000000	5	0xF0 and len as four bytes

- Each word is encoded as length, followed by that many bytes of content;
- Words are grouped into sentences. End of sentence is terminated by zero length word;
- Scheme allows encoding of length up to **0x7FFFFFFFFF**, only four byte length is supported;
- Bytes of **len** are sent most significant first (network order);
- If first byte of word is **>= 0xF8**, then it is a reserved control byte. After receiving unknown control byte API client cannot proceed, because it cannot know how to interpret following bytes;
- Currently control bytes are not used;

In general *words* can be described like this <<*encoded word length*><*word content*>>. *Word content* can be separated in 5 parts: *command word*, *attribute word*, *API attribute word*. *query word* and *reply word*

Command word

First word in sentence has to be command followed by attribute words and zero length word or terminating word. Name of command word should begin with '/'. Names of commands closely follow CLI, with spaces replaced with '/'. There are commands that are specific to API;

Command word structure in strict order:

- encoded length
- content prefix /
- CLI converted command

API specific commands:

```
getall
login
cancel
```

Command word concent examples:

```
/login
```

```
/ip/address/getall
```

```
/user/active/listen
```

```
/interface/vlan/remove
```

```
/system/reboot
```

Attribute word

Each *command word*have its own list of *attribute words* depending on content.

Atribute word structure consists of 5 parts in this order:

- encoded length
- content prefix equals sigh - =
- attribute name
- separating equals sign - =
- value of attribute if there is one. It is possible that attribute does not have a value

Note: Value can hold multiple *equal* signs in the value of *attribute word* since the way word is encoded

Note: Value can be empty

Examples without encoded length prefix:

```
=address=10.0.0.1
```

```
=name=iu=c3Eeg
```

```
=disable-running-check=yes
```

Warning: Order of attribute words and API parameters is not important and should not be relied on

API attribute word

API attribute word structure is in strict order:

- encoded length
- content prefix with dot .
- attribute name
- name postfixed with equals =sign
- attribute value

Currently the only such API attribute is *tag*.

Note: If sentence contain *API attribute word* tag then each returned sentence in reply from router to that tagged sentence will be tagged with same tag.

Query word

Senteces can have additional query paramteres that restrict their scope. They are explained in detail in separate section.

Example of sentence using query word attributes:

```
/interface/print
?type=ether
?type=vlan
?#|!
```

- Query words begin with '?'.
- Currently only *print* command handles query words.

Warning: Order of query words is significant

Reply word

It is sent only by the router. It is only sent in response to full sentence send by the client.

- First word of reply begins with '!';
- Each sentence sent generates at least one reply (if connection does not get terminated);
- Last reply for every sentence is reply that has first word `!done`;
- Errors and exceptional conditions begin with `!trap`;
- Data replies begin with `!re`
- If API connection is closed, RouterOS sends `!fatal` with reason as reply and then closes the connection;

API sentences

API sentence is main object of communication using API.

- Empty sentences are ignored.
- Sentence is processed after receiving zero length word.
- There is a limit on number and size of sentences client can send before it has logged in.
- Order of attribute words should not be relied on. As order and count is changeable by *.proplist* attribute.
- Sentence structure is as follows:
  - First word should contain *command word*;
  - Should contain *zero length word* to terminate the sentence;
  - Can contain none or several *attribute words*. There is no particular order at what attribute words has to be sent in the sentence, order is not important for *attribute words*;
  - Can contain none or several *query words*. Order of *query words* in the sentence is important.

Note: *Zero length word* terminates the sentence. If it is not provided router will not start to evaluate sent words and will consider all the input as part of the same sentence.

Initial login

```
/login
```

```
!done
=ret=ebddd18303a54111e2dea05a92ab46b4
```

```
/login
=name=admin
=response=001ea726ed53ae38520c8334f82d44c9f2
```

```
!done
```

Note: that each command and response ends with an empty word.

- First, clients sends `/login` command.
- Reply contains `=ret=`*`challenge`* argument.
- Client sends second `/login` command, with `=name=`*`username`* and `=response=`*`response`*.

- In case of error, reply contains `=ret=`*`error message`*.
- In case of successful login client can start to issue commands.

Tags

- It is possible to run several commands simultaneously, without waiting for previous one to complete. If API client is doing this and needs to differentiate command responses, it can use 'tag' API parameter in command sentences.
- If you include 'tag' parameter with non-empty value in command sentence, then 'tag' parameter with exactly the same value will be included in all responses generated by this command.
- If you do not include 'tag' parameter or it's value is empty, then all responses for this command will not have 'tag' parameter.

Command description

- `/cancel`
  - optional argument: `=tag=`*`tag of command to cancel`*, without it cancels all running commands
  - does not cancel itself
  - all canceled commands are interruped and in the usual case generate '!trap' and '!done' responses
  - please note that `/cancel` is separate command and can have it's own unique '.tag' parameter, that is not related to '=tag' argument of this command
- `listen`
  - `listen` command is avaliable where console print command is available, but it does not have expected effect everywhere (i.e. may not work)
  - `!re` sentences are generated as something changes in particular item list
  - when item is deleted or dissapears in any other way, the '!re' sentence includes value '=.dead=yes'
  - This command does not terminate. To terminate it use `/cancel` command.
- `getall`
  - `getall` command is available where console print command is available. Since version 3.21 `getall` is an alias for `print`.
  - replies contain `=.id=`*`Item internal number`* property.
- `print`
  - API `print` command differs from the console counterpart in the following ways:
    - `where` argument is not supported. Items can be filtered using query words (see below).
    - `.proplist` argument is a comma separated list of property names that should be included for the returned items.
      - returned items may have additional properties.
      - order of returned properties is not defined.
      - if list contains duplicate entries, handling of such entries is not defined.
      - if propery is present in `.proplist`, but absent from the item, then that item does not have this property value (?name will evaluate to false for that item).
      - if `.proplist` is absent, all properties are included as requested by print command, even those that have slow access time (such as file contents and perfomance counters). Thus use of `.proplist` is encouraged. Omission of `.proplist` may have high perfomance penalty if =detail= argument is set.

Queries

`print` command accepts query words that limit set of returned sentences. This feature is available since RouterOS 3.21.

- Query words begin with '?'.
- Order of query words is significant. Query is evaluated starting from the first word.
- Query is evaluated for each item in the list. If query succeeds, item is processed, if query fails, item is ignored.
- Query is evaluated using a stack of boolean values. Initially stack contains infinite amount of 'true' values. At the end of evaluation, if stack contains at least one 'false' value, query fails.
- Query words operate according to the following rules:

Query	Desciption
?name	pushes 'true' if item has value of property *name*, 'false' if it does not.
?-name	pushes 'true' if item does not have value of property *name*, 'false' otherwise.
?*name*=*x* **?=*name*=*x***	pushes 'true' if property *name* has value equal to *x*, 'false' otherwise.
?<name=''x''''' |style=''border-bottom:1px solid gray;'' valign=''top''| pushes 'true' if property ''name'' has value less than ''x'', 'false' otherwise. |- |style=''border-bottom:1px solid gray;'' valign=''top''|'''?>name=*x*	pushes 'true' if property *name* has value greater than *x*, 'false' otherwise.
?#*operations*	applies operations to the values in the stack. • operation string is evaluated left to right. • sequence of decimal digits followed by any other character or end of word is interpreted as a stack index. top value has index 0. • index that is followed by a character pushes copy of value at that index. • index that is followed by the end of word replaces all values with the value at that index. • `!` character replaces top value with the opposite. • `&` pops two values and pushes result of logical 'and' operation. • `|` pops two values and pushes result of logical 'or' operation. • `.` after an index does nothing. • `.` after another character pushes copy of top value.

Examples:

- Get all ethernet and VLAN interfaces:

```
/interface/print
?type=ether
?type=vlan
?#|
```

- Get all routes that have non-empty comment:

```
/ip/route/print
?>comment=
```

- Forum thread with detailed explanation of use of queries [1]

OID

`print` command can return OID values for properties that are available in SNMP. This feature appeared in 3.23 version.

In console, OID values can be seen by running 'print oid' command. In API, these properties have name that ends with ".oid", and can be retrieved by adding their name to the value of '.proplist'. An example:

```
/system/resource/print
=.proplist=uptime,cpu-load,uptime.oid,cpu-load.oid
```

```
!re
=uptime=01:22:53
=cpu-load=0
=uptime.oid=.1.3.6.1.2.1.1.3.0
=cpu-load.oid=.1.3.6.1.2.1.25.3.3.1.2.1

!done
```

!trap

When for some reason API sentence fails trap is sent in return accompanied with **message** attribute and on some occasions **category** argument.

message

When API sentence fails some generic message or message from used internal process is return to give more details about failure

```
<<< /ip/address/add
<<< =address=192.168.88.1
<<< =interface=asdf
<<<
>>> !trap
>>> =category=1
>>> =message=input does not match any value of interface
```

category

if it is a general error, it is categorized and error category is returned. possible values for this attribute are

- 0 - missing item or command
- 1 - argument value failure
- 2 - execution of command interrupted
- 3 - scripting related failure
- 4 - general failure
- 5 - API related failure
- 6 - TTY related failure
- 7 - value generated with :return command

Command examples

/system/package/getall

```
/system/package/getall
```

```
!re
=.id=*5802
=disabled=no
=name=routeros-x86
=version=3.0beta2
=build-time=oct/18/2006 16:24:41
=scheduled=

!re
=.id=*5805
=disabled=no
=name=system
=version=3.0beta2
=build-time=oct/18/2006 17:20:46
=scheduled=
```

... more !re sentences ...

```
!re
=.id=*5902
=disabled=no
=name=advanced-tools
=version=3.0beta2
=build-time=oct/18/2006 17:20:49
=scheduled=

!done
```

/user/active/listen

```
/user/active/listen
```

```
!re
=.id=*68
=radius=no
=when=oct/24/2006 08:40:42
=name=admin
=address=0.0.0.0
=via=console

!re
=.id=*68
=.dead=yes
```

... more !re sentences ...

`/cancel`, simultaneous commands

```
/login
```

```
!done
=ret=856780b7411eefd3abadee2058c149a3
```

```
/login
=name=admin
=response=005062f7a5ef124d34675bf3e81f56c556
```

```
!done
```

```
-- first start listening for interface changes (tag is 2)
```

```
/interface/listen
.tag=2
```

```
-- disable interface (tag is 3)
```

```
/interface/set
=disabled=yes
=.id=ether1
.tag=3
```

```
-- this is done for disable command (tag 3)
```

```
!done
.tag=3
```

```
-- enable interface (tag is 4)
```

```
/interface/set
=disabled=no
```

```
=.id=ether1
.tag=4
-- this update is generated by change made by first set command (tag 3)
!re
=.id=*1
=disabled=yes
=dynamic=no
=running=no
=name=ether1
=mtu=1500
=type=ether
.tag=2
-- this is done for enable command (tag 4)
!done
.tag=4
-- get interface list (tag is 5)
/interface/getall
.tag=5
-- this update is generated by change made by second set command (tag 4)
!re
=.id=*1
=disabled=no
=dynamic=no
=running=yes
=name=ether1
=mtu=1500
=type=ether
.tag=2
-- these are replies to getall command (tag 5)
!re
=.id=*1
=disabled=no
=dynamic=no
=running=yes
=name=ether1
=mtu=1500
=type=ether
.tag=5
```

```
!re
=.id=*2
=disabled=no
=dynamic=no
=running=yes
=name=ether2
=mtu=1500
=type=ether
.tag=5
-- here interface getall ends (tag 5)
!done
.tag=5
-- stop listening - request to cancel command with tag 2, cancel itself uses tag 7
/cancel
=tag=2
.tag=7
-- listen command is interrupted (tag 2)
!trap
=category=2
=message=interrupted
.tag=2
-- cancel command is finished (tag 7)
!done
.tag=7
-- listen command is finished (tag 2)
!done
.tag=2
```

Example client

- this is simple API client in Python2
- example for Python3
- usage: api.py *ip-address username password*
- after that type words from keyboard, terminating them with newline
- Since empty word terminates sentence, you should press enter **twice** after last word before sentence will be sent to router.

```
#!/usr/bin/python

import sys, posix, time, md5, binascii, socket, select
```

```
class ApiRos:
    "Routeros api"
    def __init__(self, sk):
        self.sk = sk
        self.currenttag = 0

    def login(self, username, pwd):
        for repl, attrs in self.talk(["/login"]):
            chal = binascii.unhexlify(attrs['=ret'])
        md = md5.new()
        md.update('\x00')
        md.update(pwd)
        md.update(chal)
        self.talk(["/login", "=name=" + username,
                   "=response=00" + binascii.hexlify(md.digest())])

    def talk(self, words):
        if self.writeSentence(words) == 0: return
        r = []
        while 1:
            i = self.readSentence();
            if len(i) == 0: continue
            reply = i[0]
            attrs = {}
            for w in i[1:]:
                j = w.find('=', 1)
                if (j == -1):
                    attrs[w] = ''
                else:
                    attrs[w[:j]] = w[j+1:]
            r.append((reply, attrs))
            if reply == '!done': return r

    def writeSentence(self, words):
        ret = 0
        for w in words:
            self.writeWord(w)
            ret += 1
        self.writeWord('')
        return ret

    def readSentence(self):
        r = []
        while 1:
            w = self.readWord()
            if w == '': return r
```

```
            r.append(w)

    def writeWord(self, w):
        print "<<< " + w
        self.writeLen(len(w))
        self.writeStr(w)

    def readWord(self):
        ret = self.readStr(self.readLen())
        print ">>> " + ret
        return ret

    def writeLen(self, l):
        if l < 0x80:
            self.writeStr(chr(l))
        elif l < 0x4000:
            l |= 0x8000
            self.writeStr(chr((l >> 8) & 0xFF))
            self.writeStr(chr(l & 0xFF))
        elif l < 0x200000:
            l |= 0xC00000
            self.writeStr(chr((l >> 16) & 0xFF))
            self.writeStr(chr((l >> 8) & 0xFF))
            self.writeStr(chr(l & 0xFF))
        elif l < 0x10000000:
            l |= 0xE0000000
            self.writeStr(chr((l >> 24) & 0xFF))
            self.writeStr(chr((l >> 16) & 0xFF))
            self.writeStr(chr((l >> 8) & 0xFF))
            self.writeStr(chr(l & 0xFF))
        else:
            self.writeStr(chr(0xF0))
            self.writeStr(chr((l >> 24) & 0xFF))
            self.writeStr(chr((l >> 16) & 0xFF))
            self.writeStr(chr((l >> 8) & 0xFF))
            self.writeStr(chr(l & 0xFF))

    def readLen(self):
        c = ord(self.readStr(1))
        if (c & 0x80) == 0x00:
            pass
        elif (c & 0xC0) == 0x80:
            c &= ~0xC0
            c <<= 8
            c += ord(self.readStr(1))
        elif (c & 0xE0) == 0xC0:
            c &= ~0xE0
```

```
            c <<= 8
            c += ord(self.readStr(1))
            c <<= 8
            c += ord(self.readStr(1))
        elif (c & 0xF0) == 0xE0:
            c &= ~0xF0
            c <<= 8
            c += ord(self.readStr(1))
            c <<= 8
            c += ord(self.readStr(1))
            c <<= 8
            c += ord(self.readStr(1))
        elif (c & 0xF8) == 0xF0:
            c = ord(self.readStr(1))
            c <<= 8
            c += ord(self.readStr(1))
            c <<= 8
            c += ord(self.readStr(1))
            c <<= 8
            c += ord(self.readStr(1))
        return c

    def writeStr(self, str):
        n = 0;
        while n < len(str):
            r = self.sk.send(str[n:])
            if r == 0: raise RuntimeError, "connection closed by remote end"
            n += r

    def readStr(self, length):
        ret = ''
        while len(ret) < length:
            s = self.sk.recv(length - len(ret))
            if s == '': raise RuntimeError, "connection closed by remote end"
            ret += s
        return ret

def main():
    s = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
    s.connect((sys.argv[1], 8728))
    apiros = ApiRos(s);
    apiros.login(sys.argv[2], sys.argv[3]);

    inputsentence = []

    while 1:
        r = select.select([s, sys.stdin], [], [], None)
```

```
        if s in r[0]:
            # something to read in socket, read sentence
            x = apiros.readSentence()

        if sys.stdin in r[0]:
            # read line from input and strip off newline
            l = sys.stdin.readline()
            l = l[:-1]

            # if empty line, send sentence and start with new
            # otherwise append to input sentence
            if l == '':
                apiros.writeSentence(inputsentence)
                inputsentence = []
            else:
                inputsentence.append(l)

if __name__ == '__main__':
    main()
```

Example run:

```
debian@localhost:~/api-test$ ./api.py 10.0.0.1 admin ''
<<< /login
<<<
>>> !done
>>> =ret=93b438ec9b80057c06dd9fe67d56aa9a
>>>
<<< /login
<<< =name=admin
<<< =response=00e134102a9d330dd7b1849fedfea3cb57
<<<
>>> !done
>>>
/user/getall

<<< /user/getall
<<<
>>> !re
>>> =.id=*1
>>> =disabled=no
>>> =name=admin
>>> =group=full
>>> =address=0.0.0.0/0
>>> =netmask=0.0.0.0
>>>
>>> !done
>>>
```

References

[1] http://forum.mikrotik.com/viewtopic.php?f=2&t=72298

Manual:IP/Proxy

Applies to RouterOS: v3, v4

Summary

Sub-menu: `/ip proxy`
Standards: `RFC 1945, RFC 2616`

MikroTik RouterOS performs proxying of HTTP and HTTP-proxy (for FTP, HTTP and HTTPS protocols) requests. Proxy server performs Internet object cache function by storing requested Internet objects, i.e., data available via HTTP and FTP protocols on a system positioned closer to the recipient in the form of speeding up customer browsing by delivering them requested file copies from proxy cache at local network speed. MikroTik RouterOS implements the following proxy server features:

- Regular HTTP proxy – customer (itself) specify what is proxy server for him
- Transparent proxy – customer does not know about the proxy being enabled and there isn't need any additional configuration for web browser of client.
- Access list by source, destination, URL and requested method (HTTP firewall)
- Cache access list to specify which objects to cache, and which not.
- Direct Access List – to specify which resources should be accessed directly, and which - through another proxy server
- Logging facility – allows to get and to store information about proxy operation
- Parent proxy support – allows to specify other proxy server, ***('if they don't have the requested object ask their parents, or to the original server.)***

A proxy server usually is placed at various points between users and the destination server (*also known as origin server*) on the Internet. *(see Figure 10.1).*

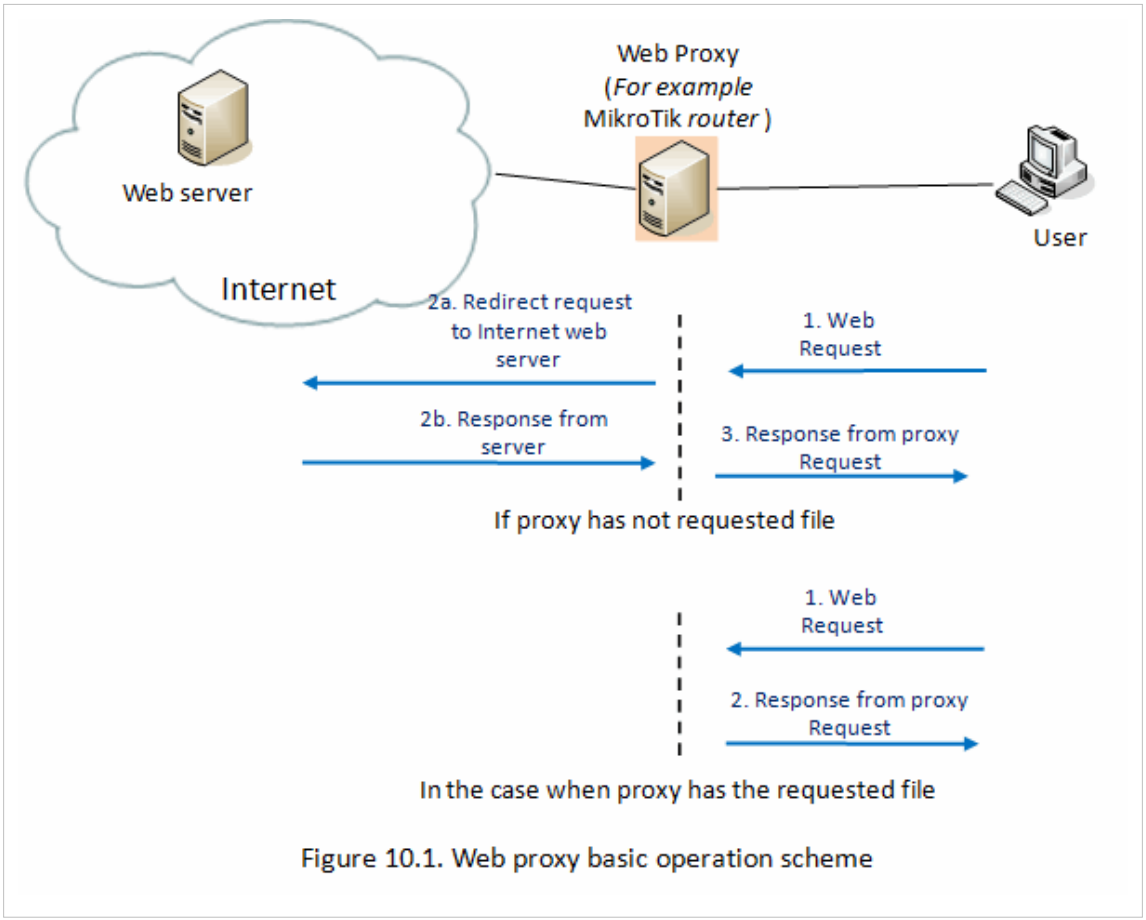

Figure 10.1. Web proxy basic operation scheme

A *Web proxy (cache)* watches requests coming from client, saving copies of the responses for itself. Then, if there is another request for the same URL, it can use the response that it has, instead of asking the origin server for it again. If proxy has not requested file, it downloads that from the original server.

There can be many potential purpose of proxy server:

- To decrease access speed to resources (it takes less time for the client to get the object).
- Works as HTTP firewall (deny access to undesirable web pages),

Allows to filter web content (by specific parameters, like source address, destination address and port, URL, HTTP request method) scan outbound content, e.g., for data leak protection.

Note: it may be useful to have Web proxy running even with no cache when you want to use it only as something like HTTP and FTP firewall (for example, denying access undesired web pages or deny specific type of files e.g. .mp3 files) or to redirect requests to external proxy (possibly, to a proxy with caching functions) transparently.

Proxy configuration example

In MikroTik RouterOS proxy configuration is performed in **/ip proxy** menu. See below how to enable the proxy on port 8080 and set up 195.10.10.1 as proxy source address:

```
[admin@MikroTik] ip proxy> set enabled=yes port=8080 src-address=195.10.10.1

[admin@MikroTik] ip proxy> print
                    enabled: yes
                src-address: 195.10.10.1
                       port: 8080
              parent-proxy: 0.0.0.0:0
               cache-drive: system
        cache-administrator: "admin@mikrotik.com"
        max-disk-cache-size: none
         max-ram-cache-size: 100000KiB
         cache-only-on-disk: yes
  maximal-client-connections: 1000
  maximal-server-connections: 1000
             max-fresh-time: 3d
```

When setting up regular proxy service, make sure it serves only your clients and prevent unauthorised access to it by creating firewall that allow only your clients to use proxy, otherwise it may be used as an open proxy.

Remember that regular proxy require also client's web browser configuration.

For example:

Explorer 8.x	**Firefox 3.x**	**Opera 10.x**
Select *Tools>Internet options.*	Select *Tools>Options.*	Select *Tool>Preferences.*
Click the *Connections tab*.	Click the *Advanced tab.*	Open the *Advanced tab/Network.*
Select the necessary connection and choose *Settings* button.	Open the *Network tab.*	Click the *Proxy servers.*
Configure proxy address and port.	Click the *Connection/Settings*	*Enter proxy address and port.*
	Select *Manual proxy configuration'*	

Transparent proxy configuration example

RouterOS can also act as a Transparent Caching server, with no configuration required in the customer's web browser. Transparent proxy does not modify requested URL or response. RouterOS will take all HTTP requests and redirect them to the local proxy service. This process will be entirely transparent to the user (users may not know anything about proxy server that is located between them and original server), and the only difference to them will be the increased browsing speed.

To enable the transparent mode, firewall rule in destination NAT has to be added, specifying which connections (to which ports) should be transparently redirected to the proxy. Check proxy settings above and redirect us users (192.168.1.0/24) to proxy server.

```
[admin@MikroTik] ip firewall nat> add chain=dstnat protocol=tcp src-address=192.168.1.0/24 \
dst-port=80 action=redirect to-ports=8080

 [admin@MikroTik] ip firewall nat> print
 Flags: X - disabled, I - invalid, D - dynamic
```

```
 0   chain=dstnat protocol=tcp dst-port=80 action=redirect to-ports=8000
[admin@MikroTik] ip firewall nat>
```

The web proxy can be used as transparent and normal web proxy at the same time. In transparent mode it is possible to use it as standard web proxy, too. However, in this case, proxy users may have trouble to reach web pages which are accessed transparently.

Proxy based firewall – Access List

Access list is implemented in the same way as MikroTik firewall rules processed from the top to the bottom. First matching rule specifies decision of what to do with this connection. Connections can be matched by its source address, destination address, destination port, sub-string of requested URL (Uniform Resource Locator) or request method. If none of these parameters is specified, every connection will match this rule.

If connection is matched by a rule, action property of this rule specifies whether connection will be allowed or not (deny). If connection does not match any rule, it will be allowed.

In this example assume that we have configured transparent proxy server as given in example above.

Block particular Websites.

```
/ip proxy access add dst-host=www.facebook.com action=deny
```

It will block website http://www.facebook.com [1], we can always block the same for different networks by giving src-address.

```
/ip proxy access add src-address=192.168.1.0/24 dst-host=www.facebook.com action=deny
```

Users from network 192.168.1.0/24 will not be able to access website www.facebook.com [1].

You can block also websites that contain specific words in URL:

```
/ip proxy access add dst-host=:mail action=deny
```

This statement will block all websites which contain word “mail” in URL. Like www.mail.com [2], www.hotmail.com [3], mail.yahoo.com etc.

We can also stop downloading specific types of files like .flv, .avi, .mp4, .mp3, .exe, .dat, …etc.

```
/ip proxy access
add path=*.flv action=deny
add path=*.avi action=deny
add path=*.mp4 action=deny
add path=*.mp3 action=deny
add path=*.zip action=deny
add path=*.rar action=deny.
```

Here are available also different wildcard characters, to creating specific conditions and to match it by proxy access list.

Wildcard properties (dst-host and dst-path) match a complete string (i.e., they will not match "example.com" if they are set to "example"). Available wildcards are '*' (match any number of any characters) and '?' (match any one character).

Regular expressions are also accepted here, but if the property should be treated as a regular expression, it should start with a colon (':').

To show that no symbols are allowed before the given pattern, we use ^ symbol at the beginning of the pattern.

To specify that no symbols are allowed after the given pattern, we use $ symbol at the end of the pattern.

Reference

List of all available parameters and commands per menu.

General

Sub-menu: `/ip proxy`

Property	Description
always-from-cache (*yes* | *no*; Default: **no**)	
cache-administrator (*string*; Default: **webmaster**)	Administrator's e-mail displayed on proxy error page
cache-hit-dscp (*integer: 0..63*; Default: **4**)	
cache-on-disk (*yes* | *no*; Default: **no**)	
max-cache-size (*none* | *unlimited* | *integer: 0..4294967295*; Default: **none**)	Specifies the maximal cache size, measured in kibibytes
max-client-connections (*integer: 1..5000*; Default: **600**)	Maximal number of connections accepted from clients (any further connections will be rejected)
max-fresh-time (*time*; Default: **3d**)	Maximal time to store a cached object. The validity period of an object is is usually defined by the object itself, but in case it is set too high, you can override the maximal value
max-server-connections (*integer: 1..5000*; Default: **600**)	Maximal number of connections made to servers (any further connections from clients will be put on hold until some server connections will terminate)
parent-proxy (*Ip4* | *ip6*; Default: **0.0.0.0**)	IP address and port of another HTTP proxy to redirect all requests to. If set to **0.0.0.0** parent proxy is not used.
parent-proxy-port (*integer: 0..65535*; Default: **0**)	Port that parent proxy is listening on.
port (*integer: 0..65535*; Default: **8080**)	TCP port the proxy server will be listening on. This port have to be specified on all clients that want to use the server as HTTP proxy. Transparent (with zero configuration for clients) proxy setup can be made by redirecting HTTP requests to this port in IP firewall using destination NAT feature
serialize-connections (*yes* | *no*; Default: **no**)	
src-address (*Ip4* | *Ip6*; Default: **0.0.0.0**)	Proxy will use specified address when connecting to parent proxy or web site. If set to **0.0.0.0** then appropriate IP address will be taken from routing table.

Access List

Sub-menu: `/ip proxy access`

Access list is configured like a regular firewall rules. Rules are processed from the top to the bottom. First matching rule specifies decision of what to do with this connection. There is a total of 6 classifiers that specify matching constraints. If none of these classifiers is specified, the particular rule will match every connection.

If connection is matched by a rule, action property of this rule specifies whether connection will be allowed or not. If the particular connection does not match any rule, it will be allowed.

Property	Description
action (*allow* | *deny*; Default: **allow**)	Specifies whether to pass or deny matched packets
dst-address (*Ip4[-Ip4 | /0..32] | Ip6/0..128*; Default:)	Destination address of the target server.
dst-host (*string*; Default:)	IP address or DNS name used to make connection the target server (this is the string user wrote in browser before specifying port and path to a particular web page
dst-port (*integer[-integer[,integer[,...]]]: 0..65535*; Default:)	List or range of ports the packet is destined to
local-port (*integer: 0..65535*; Default:)	Specifies the port of the web proxy via which the packet was received. This value should match one of the ports web proxy is listening on.
method (*any* | *connect* | *delete* | *get* | *head* | *options* | *post* | *put* | *trace*; Default:)	HTTP method used in the request (see HTTP Methods section in the end of this document)
path (*string*; Default:)	Name of the requested page within the target server (i.e. the name of a particular web page or document without the name of the server it resides on)
redirect-to (*string*; Default:)	In case access is denied by this rule, the user shall be redirected to the URL specified here
src-address (*Ip4[-Ip4 | /0..32] | Ip6/0..128*; Default:)	Source address of the connection originator.

Read only properties:

Property	Description
hits (*integer*)	Count of requests that were matched by this rule

Wildcard properties (dst-host and dst-path) match a complete string (i.e., they will not match "example.com" if they are set to "example"). Available wildcards are '*' (match any number of any characters) and '?' (match any one character). Regular expressions are also accepted here, but if the property should be treated as a regular expression, it should start with a colon (':').

Small hints in using regular expressions:

- \\ symbol sequence is used to enter \ character in console
- \. pattern means . only (in regular expressions single dot in pattern means any symbol)
- to show that no symbols are allowed before the given pattern, we use ^ symbol at the beginning of the pattern
- to specify that no symbols are allowed after the given pattern, we use $ symbol at the end of the pattern
- to enter [or] symbols, you should escape them with backslash \.

It is strongly recommended to deny all IP addresses except those behind the router as the proxy still may be used to access your internal-use-only (intranet) web servers. Also, consult examples in Firewall Manual on how to protect your router.

Direct Access

Sub-menu: `/ip proxy direct`

If **parent-proxy** property is specified, it is possible to tell proxy server whether to try to pass the request to the parent proxy or to resolve it connecting to the requested server directly. Direct Access List is managed just like Proxy Access List described in the previous chapter except the action argument.

Unlike the access list, the direct proxy access list has default action equal to deny. It takes place when no rules are specified or a particular request did not match any rule.

Property	Description
action (*allow* | *deny*; Default: **allow**)	Specifies the action to perform on matched packets: • `allow` - always resolve matched requests directly bypassing the parent router • `deny` - resolve matched requests through the parent proxy. If no one is specified this has the same effect as **allow**.
dst-address (*Ip4[-Ip4 | /0..32] | Ip6/0..128*; Default:)	Destination address of the target server.
dst-host (*string*; Default:)	IP address or DNS name used to make connection the target server (this is the string user wrote in browser before specifying port and path to a particular web page
dst-port (*integer[-integer[,integer[,...]]]: 0..65535*; Default:)	List or range of ports used by connection to target server.
local-port (*integer: 0..65535*; Default:)	Specifies the port of the web proxy via which the packet was received. This value should match one of the ports web proxy is listening on.
method (*any* | *connect* | *delete* | *get* | *head* | *options* | *post* | *put* | *trace*; Default:)	HTTP method used in the request (see HTTP Methods section in the end of this document)
path (*string*; Default:)	Name of the requested page within the target server (i.e. the name of a particular web page or document without the name of the server it resides on)
src-address (*Ip4[-Ip4 | /0..32] | Ip6/0..128*; Default:)	Source address of the connection originator.

Read only properties:

Property	Description
hits (*integer*)	Count of requests that were matched by this rule

Cache Management

Sub-menu: `/ip proxy cache`

Cache access list specifies, which requests (domains, servers, pages) have to be cached locally by web proxy, and which not. This list is implemented exactly the same way as web proxy access list. Default action is to cache object (if no matching rule is found).

Property	Description
action (*allow* | *deny*; Default: **allow**)	Specifies the action to perform on matched packets: • `allow` - cache objects from matched request • `deny` - do not cache objects from matched request
dst-address (*Ip4[-Ip4 | /0..32] | Ip6/0..128*; Default:)	Destination address of the target server
dst-host (*string*; Default:)	IP address or DNS name used to make connection the target server (this is the string user wrote in browser before specifying port and path to a particular web page
dst-port (*integer[-integer[,integer[,...]]]: 0..65535*; Default:)	List or range of ports the packet is destined to.
local-port (*integer: 0..65535*; Default:)	Specifies the port of the web proxy via which the packet was received. This value should match one of the ports web proxy is listening on.
method (*any* | *connect* | *delete* | *get* | *head* | *options* | *post* | *put* | *trace*; Default:)	HTTP method used in the request (see HTTP Methods section in the end of this document)
path (*string*; Default:)	Name of the requested page within the target server (i.e. the name of a particular web page or document without the name of the server it resides on)
src-address (*Ip4[-Ip4 | /0..32] | Ip6/0..128*; Default:)	Source address of the connection originator

Read only properties:

Property	Description
hits (*integer*)	Count of requests that were matched by this rule

Connections

Sub-menu: `/ip proxy connections`

This menu conntains the list of current connections the proxy is serving.

Read only properties:

Property	Description
client ()	
dst-address (*Ip4* | *Ip6*)	IPv4/Ipv6 destination address of the connection
protocol (*string*)	Protocol name
rx-bytes (*integer*)	The amount of bytes received by the client
server ()	
src-address (*Ip4* | *Ip6*)	Ipv4/ipv6 address of the connection originator

state (*closing* | *connecting* | *converting* | *hotspot* | *idle* | *resolving* | *rx-header* | *tx-body* | *tx-eof* | *tx-header* | *waiting*)	Connection state: • `closing` - the data transfer is finished, and the connection is being finalized • `connecting` - establishing toe connection • `converting` - replacing header and footer fields in response or request paket • `hotspot` - check if hotspot authentication allows to continue (for hotspot proxy) • `idle` - staying idle • `resolving` - resolving server's DNS name • `rx-header` - receiving HTTP header • `tx-body` - transmitting HTTP body to the client • `tx-eof` - writing chunk-end (when converting to chunked response) • `tx-header` - transmitting HTTP header to the client • `waiting` - waiting for transmission form a peer
tx-bytes (*integer*)	The amount of bytes sent by the client

Cache Inserts

Sub-menu: `/ip proxy inserts`

This menu shows statistics on objects stored in cache (cache inserts).

Read only properties:

Property	Description
denied (*integer*)	Number of inserts denied by the caching list.
errors (*integer*)	Number of disk or other system-related errors
no-memory (*integer*)	Number of objects not stored because there was not enough memory
successes (*integer*)	Number of successfull cache inserts.
too-large (*integer*)	Number of objects too large to store

Cache Lookups

Sub-menu: `/ip proxy lookup`

This menu shows statistics on objects read from cache (cache lookups).

Read only properties:

Property	Description
denied (*integer*)	Number of requests denied by the access list.
expired (*integer*)	Number of requests found in cache, but expired, and, thus, requested from an external server
no-expiration-info (*integer*)	Conditional request received for a page that does not have the information to compare the request with
non-cacheable (*integer*)	Number of requests requested from the external servers unconditionally (as their caching is denied by the cache access list)
not-found (*integer*)	Number of requests not found in the cache, and, thus, requested from an external server (or parent proxy if configured accordingly)
successes (*integer*)	Number of requests found in the cache.

Cache Contents

Sub-menu: `/ip proxy cache-contents`

This menu shows cached contents.

Read only properties:

Property	Description
file-size (*integer*)	Cached object size
last-accessed (*time*)	
last-accessed-time (*time*)	
last-modified (*time*)	
last-modified-time (*time*)	
uri (*string*)	

HTTP Methods

Options

This method is a request of information about the communication options available on the chain between the client and the server identified by the **Request-URI**. The method allows the client to determine the options and (or) the requirements associated with a resource without initiating any resource retrieval

GET

This method retrieves whatever information identified by the Request-URI. If the Request-URI refers to a data processing process than the response to the GET method should contain data produced by the process, not the source code of the process procedure(-s), unless the source is the result of the process.

The GET method can become a conditional GET if the request message includes an If-Modified-Since, If-Unmodified-Since, If-Match, If-None-Match, or If-Range header field. The conditional GET method is used to reduce the network traffic specifying that the transfer of the entity should occur only under circumstances described by conditional header field(-s).

The GET method can become a partial GET if the request message includes a Range header field. The partial GET method intends to reduce unnecessary network usage by requesting only parts of entities without transferring data already held by client.

The response to a GET request is cacheable if and only if it meets the requirements for HTTP caching.

HEAD

This method shares all features of GET method except that the server must not return a message-body in the response. This retrieves the metainformation of the entity implied by the request which leads to a wide usage of it for testing hypertext links for validity, accessibility, and recent modification.

The response to a HEAD request may be cacheable in the way that the information contained in the response may be used to update previously cached entity identified by that Request-URI.

POST

This method requests that the origin server accept the entity enclosed in the request as a new subordinate of the resource identified by the Request-URI.

The actual action performed by the POST method is determined by the origin server and usually is Request-URI dependent.

Responses to POST method are not cacheable, unless the response includes appropriate Cache-Control or Expires header fields.

PUT

This method requests that the enclosed entity be stored under the supplied Request-URI. If another entity exists under specified Request-URI, the enclosed entity should be considered as updated (newer) version of that residing on the origin server. If the Request-URI is not pointing to an existing resource, the origin server should create a resource with that URI.

If the request passes through a cache and the Request-URI identifies one or more currently cached entities, those entries should be treated as stale. Responses to this method are not cacheable.

TRACE

This method invokes a remote, application-layer loop-back of the request message. The final recipient of the request should reflect the message received back to the client as the entity-body of a 200 (OK) response. The final recipient is either the origin server or the first proxy or gateway to receive a Max-Forwards value of 0 in the request. A TRACE request must not include an entity.

Responses to this method MUST NOT be cached.

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References

[1] http://www.facebook.com
[2] http://www.mail.com
[3] http://www.hotmail.com

Manual:Tools/Fetch

Applies to RouterOS: v3, v4 +

Summary

Sub-menu: `/tool fetch`
Standards:

Fetch is one of the console tools in Mikrotik RouterOS. It is used to copy files from any network device to a Mikrotik router via HTTP or FTP.

In latest v5 versions it is possible also to upload files to remote locations.

Fetch now supports HTTPS protocol. By default no certificate checks are made, but setting **check-certificate** to *yes* enables trust chain validation from local certificate store. CRL checking is never done.

Properties

Property	Description
address (*string*; Default:)	IP address of the device to copy file from.
ascii (*yes* | *no*; Default: **no**)	
check-certificate (*yes* | *no*; Default: **no**)	Enables trust chain validation from local certificate store.
dst-path (*string*; Default:)	Destination filename and path
host (*string*; Default:)	Domain name or virtual domain name (if used on web-site, from which you want to copy information). For example, `address=wiki.mikrotik.com host=forum.mikrotik.com` In this example the resolved ip address is the same (66.228.113.27), but hosts are different.
keep-result (*yes* | *no*; Default: **yes**)	If yes, creates an input file.
mode (*ftp|http|tftp {!} https*; Default: **http**)	Choose the protocol of connection - http, https , ftp or tftp.
password (*string*; Default: **anonymous**)	Password, which is needed for authentication to the remote device.
port (*integer*; Default:)	Connection port.
src-path (*string*; Default:)	Title of the remote file you need to copy.
upload (*yes* | *no*; Default: **no**)	If enabled then fetch will be used to upload file to remote server. Requires *src-path* and *dst-path* parameters to be set.
url (*string*; Default:)	URL pointing to file. Can be used instead of **address** and **src-path** parameters.
user (*string*; Default: **anonymous**)	User name, which is needed for authentication to the remote device.

Examples

The following example shows how to copy the file with filename "conf.rsc" from device with ip address 192.168.88.2 by FTP protocol and save it as file with filename "123.rsc". User and password are needed to login into the device.

```
[admin@mt-test] /tool> fetch address=192.168.88.2 src-path=conf.rsc \
user=admin mode=ftp password=123 dst-path=123.rsc port=21 \
host="" keep-result=yes
```

Example to upload file to other router:

```
[admin@mt-test] /tool> fetch address=192.168.88.2 src-path=conf.rsc \
user=admin mode=ftp password=123 dst-path=123.rsc upload=yes
```

Another example that demonstrates the usage of `url` property.

```
[admin@test_host] /> /tool fetch url="http://www.mikrotik.com/img/netaddresses2.pdf" mode=http
  status: finished

[admin@test_host] /> /file print
 # NAME                    TYPE                SIZE                CREATION-TIME
 ...
 5 netaddresses2.pdf       .pdf file           11547               jun/01/2010 11:59:51
```

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